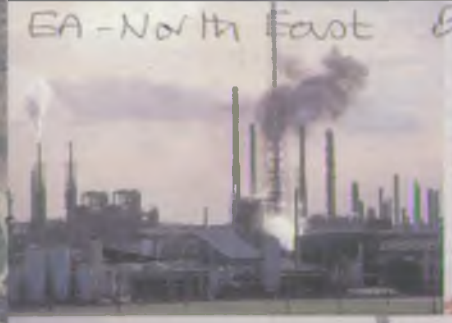

Tees Estuary Present & Future

State of the Tees Estuary environment, and strategy into the millennium

June 1999

ENVIRONMENT AGENCY

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Foreword

From a position in 1970 when the Tees Estuary was virtually dead, significant progress has been made to bring the estuary back to life. With improvements already made and those planned to discharges of industrial and sewage effluents it is projected that by 2002 the targets set in 1980, to re-establish a migratory fishery, will have been achieved.

When the estuary was grossly polluted it was clear what the priorities for improvement were. The issue was the money that was needed to finance the improvements and the timing. Decisions for the future are, however, much more difficult. The holy grail of a 'sustainable' estuary; where industry and nature conservation co-exist and where we balance the social, economic and environmental impacts of improvements is what we are seeking to achieve. But how do we achieve it? This document seeks to suggest a framework for a way forward.

The first section of this report details the present State of the Tees Estuary in terms of both water quality and animals that live in the estuary. For example, for the first time in over 50 years, there is now dissolved oxygen present throughout the estuary at all times of the year. This was first achieved in 1997. The types and abundance of animals that live in the estuary are responding to the improved water quality. Seals are now successfully breeding again, salmon are able to pass through the estuary and species that live on the estuary bed, although still at low levels, are increasing in types and abundance.

The second section raises issues that will need consideration if these objectives are to be met. Future targets, objectives and indicators for the estuary are suggested in this section. Up to now the emphasis of improvements has been to reduce the inputs of pollutants that remove oxygen from the water and substances such as ammonia that has well documented toxicity to estuarine life. As the estuary has recovered from the impact of gross pollution however, other issues have become apparent. The Tees Barrage has altered tidal currents and mixing in the estuary. Historically polluted sediment is now proved to be a cause of oxygen depletion. Studies are ongoing to establish methods of determining the toxicity of complex chemical effluents containing a mixture of substances. Certain substances are implicated as affecting the reproduction of species within the estuary. Are nutrients beneficial to the productivity of the internationally significant conservation areas at the mouth of the estuary or are they detrimental leading to excessive growth of algal mats? The report highlights current environmental issues that will need to be taken into account if the future objectives are to be achieved.

What we would like to see as a result of this report and consultation is a future vision that we can all sign up to and move towards over the next 10 years or so. The targets set in 1980, based on salmon, were innovative at that time. We are suggesting that future targets are also linked to species that are resident or have the potential to be resident in the estuary. From these targets after considering all the issues identified, we would agree the improvements that are needed and then move forward to achieving them over a sensible timescale. Reporting progress towards achieving these targets would form an essential part of the overall strategy, as would the need to base decisions on sound science.

One of the reasons for the significant progress in improving water quality over the last 10 years has been that the fact that all concerned committed themselves to achieving the objective of migratory fish passage through the estuary. It is fundamental that this partnership approach is taken forward in the future. Views are therefore requested on the proposals in the report and how they might best be agreed, reported on and periodically reviewed. Comments on the report should be made to Bob Pailor by 15th September 1999.

The Environment Agency would like to thank English Nature, Durham University, INCA and local industry for their help in producing this report.

Contents

Part 1: *The State of the Tees Estuary*

Part 1 – *introduction*

The Environment Agency has a central role in managing the environment of the Tees Estuary. A sound scientific understanding of the state of the Tees Estuary environment and how it is responding to the various pressures placed upon it is therefore essential. This can be effectively achieved with a monitoring and assessment programme included in the Agency' overall strategy for the estuary.

The strategy provides a basis for meeting statutory monitoring requirements, assessing priorities for action, charting progress with respect to environmental management plans and targets and producing useful information on the state of the estuary environment to all interested parties and the general public.

This report provides a 'snapshot' of the current state of the estuary, primarily in relation to its water quality, within a framework of objectives, targets and indicators. The framework is set out in Appendix 1, Tables A1.1 and A1.2. A map outlining the Tees Estuary and principal discharges into it is shown in figure 1.

PHYSICAL CHARACTERISTICS AND HYDROGRAPHY OF THE ESTUARY

General

The River Tees is 160km long and rises at Tees Head in the Cumbrian Pennines at 893m above sea level. It flows over open moorland to Cow Green Reservoir, east south east through Teesdale towards Barnard Castle and turns east towards Darlington. Then it widens and flows over an extensive plain bounded by the Cleveland Hills to the south and the hills of Durham to the north towards the heavily industrialised Tees Estuary, which has large areas reclaimed from salt marshes and mudflats. The river ends at Tees Bay, a shallow embankment of the North Sea.

Geomorphology

The upland Tees flows over hard rock, while on the estuarine lowland the solid geology is overlain by deposits of clay, peat, alluvium, river gravels and blown sands. The floor of Tees Bay is composed of sandy sediments, with sandy beaches backed by dunes.

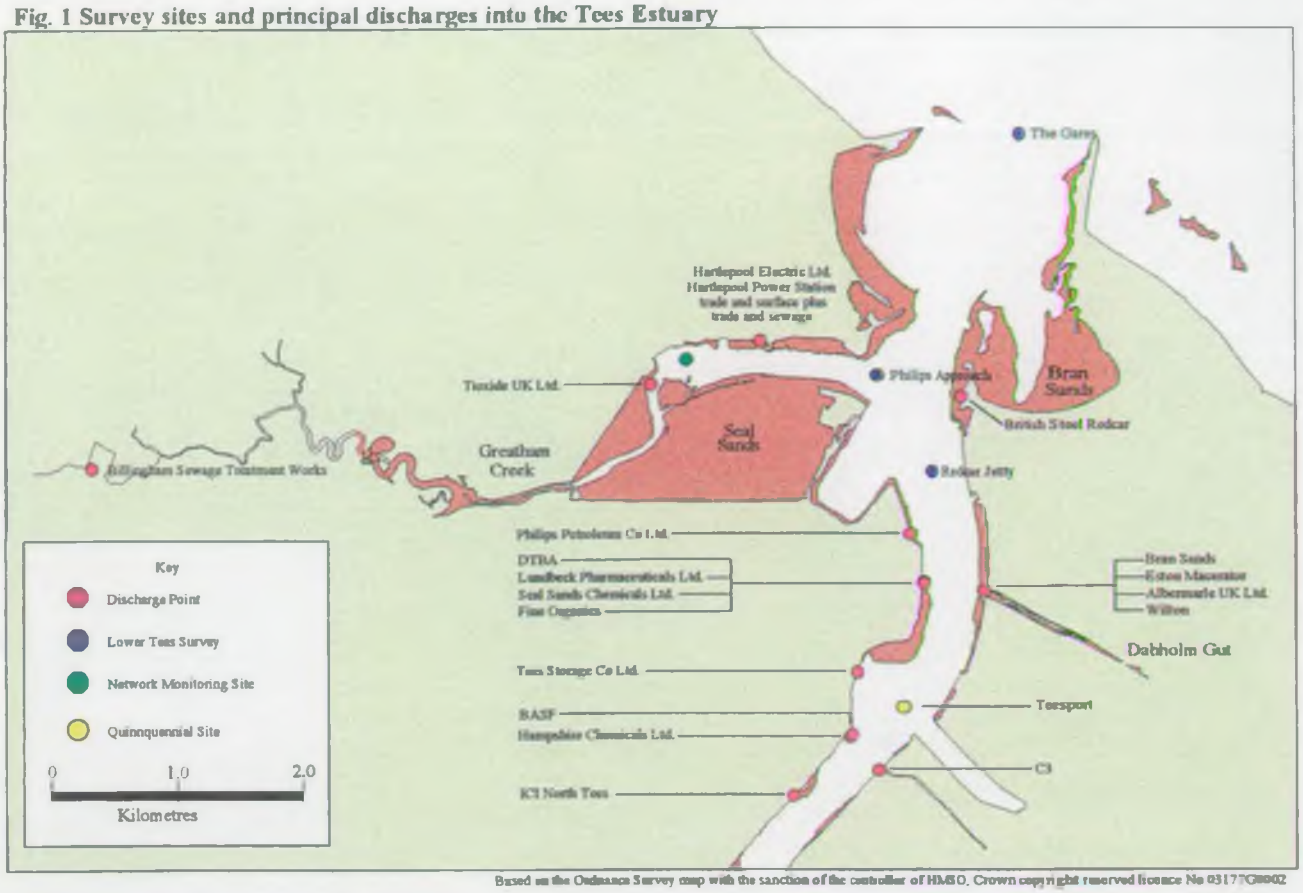
Water Circulation

River flow is recorded at the barrage, Broken Scar and Low Moor. The flow responds rapidly to rainfall and increased flows are accommodated by many reservoirs in the upper Tees. These tend to moderate flood flows and sustain a minimum flow during dry periods.

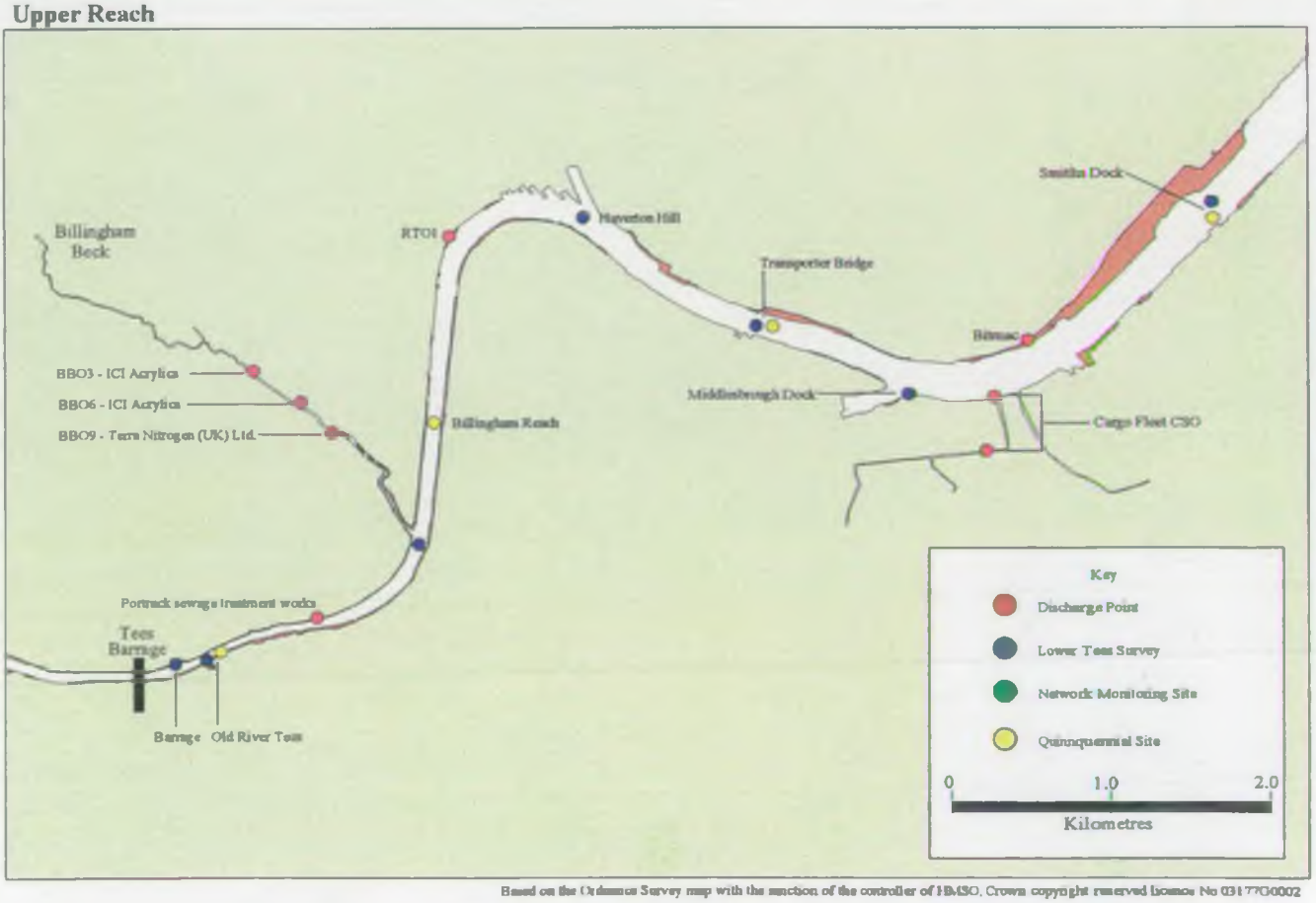
The Tees Barrage came into operation in January 1995. Before its construction, the River Tees was some 44km in length from the tidal limit to the sea and the saline intrusion used to penetrate about 28km from the estuary mouth. The strength of the tidal currents was not sufficient to produce complete mixing over the full length of the estuary and the system was classified as partially stratified.

The construction of the barrage prevented the access of saline waters to the upper portion of the estuary, reducing the estuary to 18km in length and turning the upstream section into a freshwater river. The barrage determines the upstream limit of the estuary and the limit of saline intrusion.

Fig. 1 Survey sites and principal discharges into the Tees Estuary



Upper Reach



Differences in salinity between surface and bottom measurements suggest that the system now tends to stratify on the ebb tide and become relatively well mixed during the flood tide.

The steady longitudinal gradient in the salinity of the near surface waters has been replaced by a much smaller gradient along most of the estuary extension and a steep gradient up to the face of the barrage. As a result of these changes, a significant amount of dynamic energy in the system has been lost. There has been a change to the deposition of highly organic fine sediments in the upper and middle estuary and of coarser, marine-derived sediments at Teesmouth, though changes in sedimentation patterns may also be influenced by changes in dredging patterns and methods. Increased stratification can be associated with low dissolved oxygen concentrations in the lower layers of the water column, as the system has lost the oxygen input of the mixing with upper water layers. The impact of these changes to the ecology and water quality of the estuary poses considerable challenges to the management of the Tees estuarine environment.

ECOLOGICAL OBJECTIVES

Seals

The objective is to encourage and maintain a healthy, breeding Common Seal colony at Teesmouth.

The common or Harbour Seal (*Phoca vitulina)* was once numerous in the Tees Estuary - in the early 19th century the population was estimated to be 1,000. The seals bred in the estuary and used inter-tidal mudflats as haul out sites, an area now known as Seal Sands. Habitat loss and disturbance, due to land reclamation and industry, caused a dramatic decline in numbers later in the century. Right up to the 1960s and early 1970s, seals were rarely recorded in the channel. However, from 1978 to 1990, an average of 20 seals were noted hauled out each year. Numbers have been gradually increasing ever since.

The Tees Seals Research Programme was initiated in 1989 to monitor the re-establishment of the colony, which is significant because it is the first documented case of seals returning to a highly industrialised area. Monitoring is intensive during the pupping season from mid-June to early September, but is also undertaken regularly throughout the rest of the year.

Both British native species of seal - the common or harbour and the grey (*Halichoerus grypus)* - are present on Seal Sands. Maximum counts are recorded on sunny, still days when the seals bask to restore energy. These maximum counts have gradually increased for both species (See Figure 2.1 and Table 1).

Seal Sands

Seal colony on Seal Sands

Waterfowl colony on Seal Sands

Enteromorpha mat on Seal Sands

Fig. 2.1 Location of Seal Haul Out Sites & Illustration of Numbers of Common & Grey Seals over time

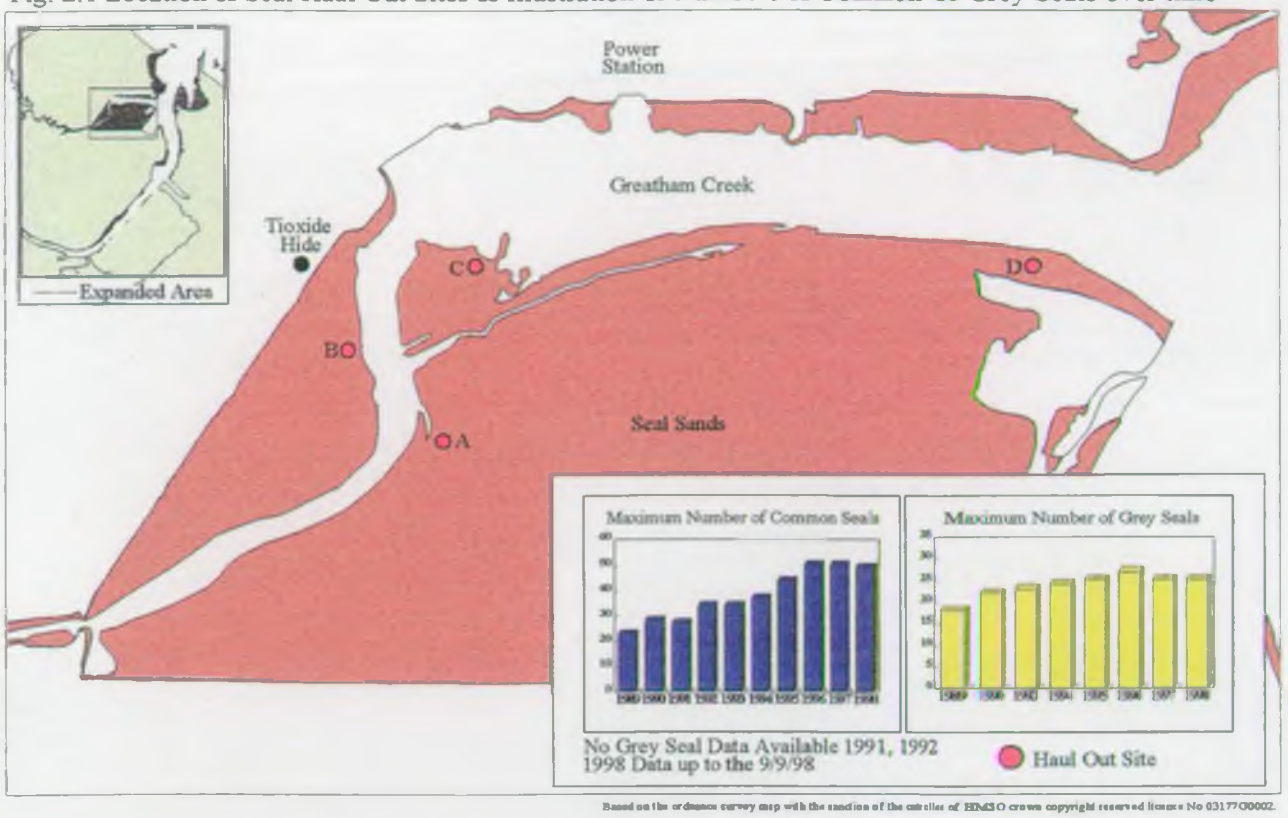


Fig. 2.2 Significant Waterfowl Roosting & Feeding Sites - Tees Estuary

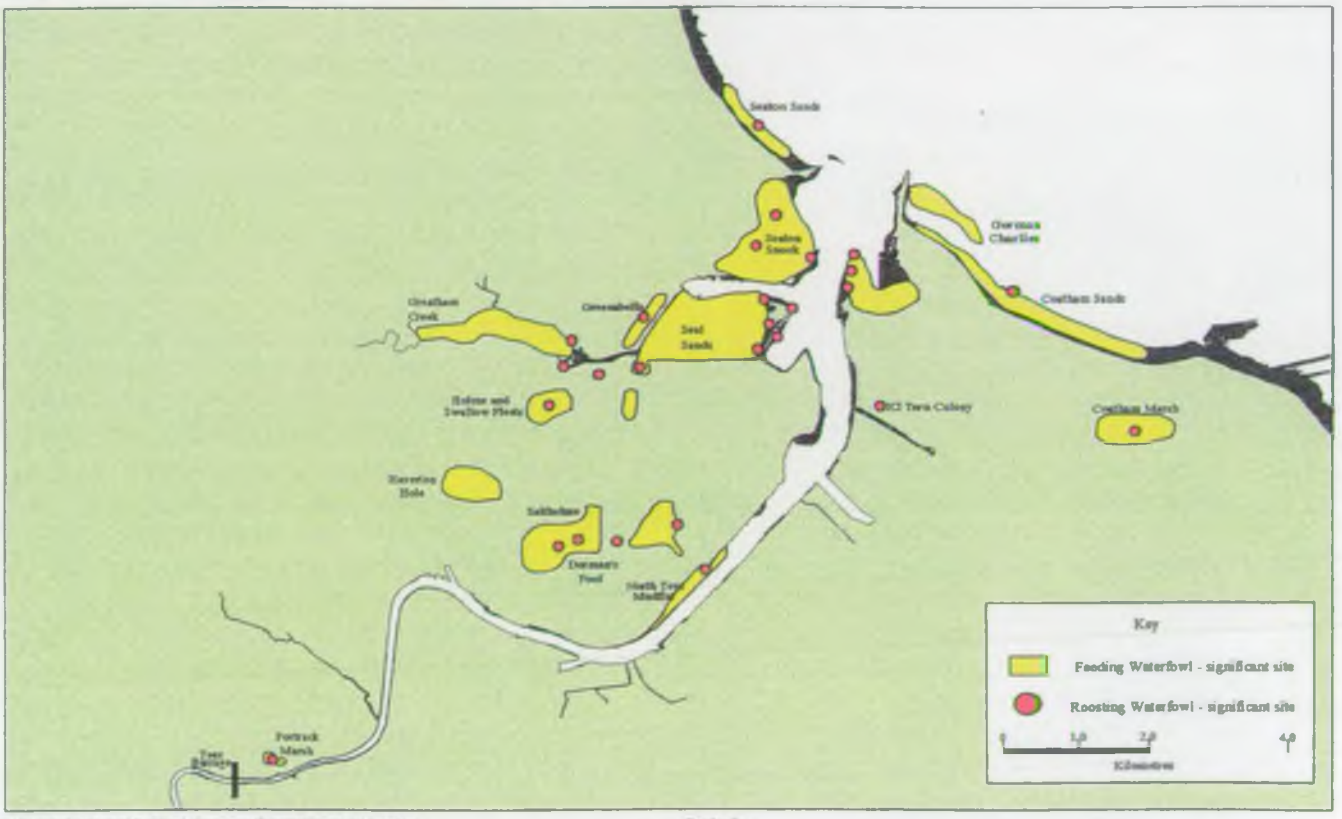


Table 1. Common and Grey Seal Maximum Counts and Status of Common Seal Pups at Seal Sands

Year	Common Seals	Grey Seals	No. Common Seal Pups Born	No. pups weaned successfully	No. pups stranded	No. pups died
1989	23	18	1	0	0	1
1990	28	22	0	-	-	-
1991	27	*	1	0	0	1
1992	34	*	0	-	-	-
1993	34	23	1	0	0	1
1994	37	24	2	2	0	0
1995	44	25	2	1	1	0
1996	50	27	2	1	1	1(during rehabilitation)
1997	50	25	4	1	2	1 (still born)
1998	49	25	4	3 / 4	0	0 / 1

The seals enter Seal Sands on the falling tide via Seaton Channel and the river mouth. Since 1989 they have favoured sites A, B, C, and D (see Figure 2.1) along the banks of the channel as haul out sites. Disturbance by various human activities, usually bait collectors or boats, has decreased in recent years. Indeed, there has been a noticeable decrease in the number of boats in the channel, partly due to information distributed to boating clubs via Tees Estuary Management Plan.

Only Common Seals breed on Seal Sands because the transient nature of the mudflats makes them unsuitable for Grey Seal breeding. Seals failed to breed successfully on Seal Sands until 1994. In 1998, four pups were born and at least three weaned successfully.

The conclusions are as follows:

Table 2. Current State of Seal Populations

Stretch	Objective	Indicators	Current State
Teesport to Gares	Encourage and maintain a healthy, breeding Common Seal colony at Teesmouth	Common Seal population maintained at specified limits (see Table 1.) Successful breeding and survival of Common Seal pups. Proportion of pups to survive beyond first year.	There has been a gradual increase in population size of the colony and successful breeding. Specified limits are maintained. Successful breeding has occurred in all years since 1994.

Salmonids

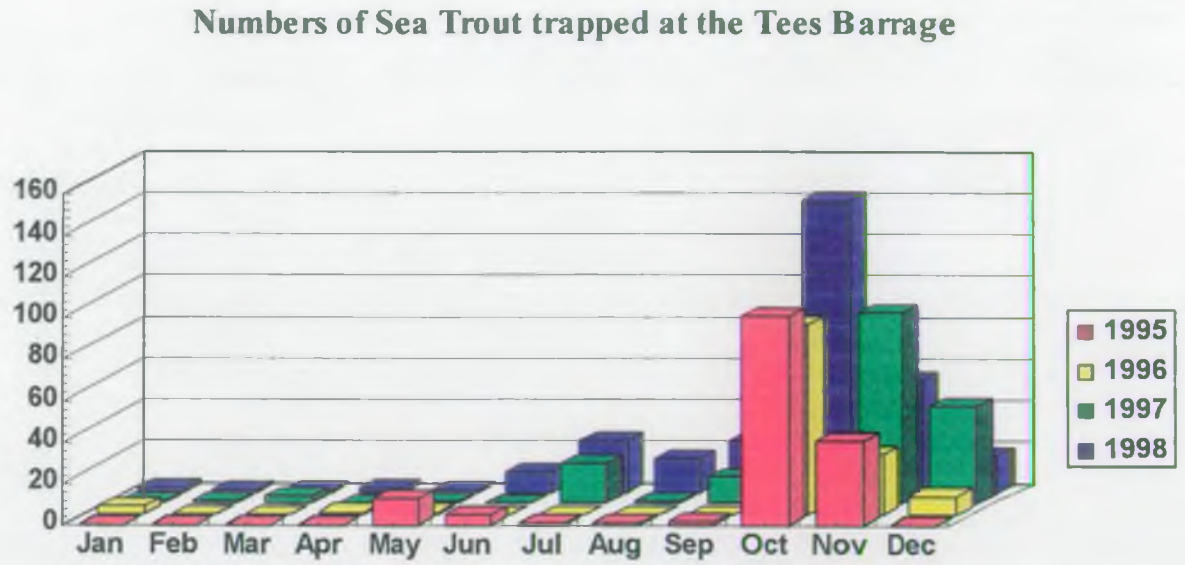
The objective is to encourage and maintain the passage of salmon and migratory sea trout smolts to sea during migration periods and returning adults at all times.

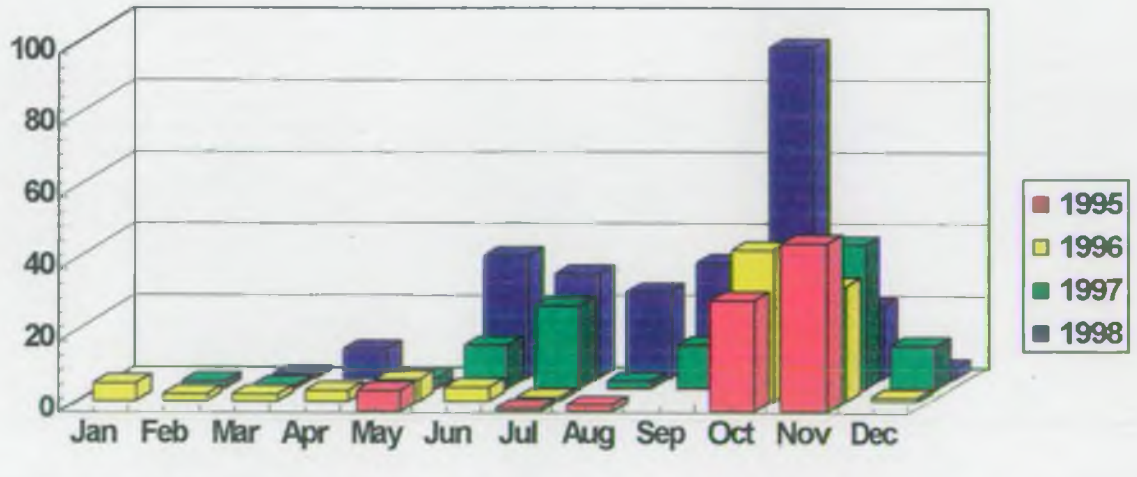
Both the Atlantic salmon (*Salmo salar)* and sea trout (*Salmo trutta)* are found in the Tees catchment. The Tees has a long history as a major salmon river, both for commercial fishing and recreational angling. During the early part of the 20th century, increasing discharges from both industrial and domestic sources resulted in rapid deterioration in water quality in the estuary, preventing the return of adult salmon and sea trout. There were no reported catches of salmon until 1982. Reductions in industrial discharges to the estuary resulted in increases in dissolved Oxygen levels making the passage of migratory fish possible. In 1991, a five-year stocking programme was initiated whereby one million salmon fry and parr were introduced to the upper Tees. This has resulted in an increase in the numbers of salmon returning to the river.

Data on the numbers of returning migratory salmonids are obtained from several sources. Within the fish pass at the Tees Barrage is a resistivity fish counter, with a trap situated immediately upstream for validation of the counts. The numbers and lengths of salmon and sea trout using the fish pass have been recorded since May 1995. The preferred route past the barrage, however, appears to be via the gates during periods of elevated river flow and at present there are no means of assessing the numbers of fish using this route. Gate number one is kept only 500mm above tidal levels to aid fish passage. During one 30 minute period in August 1998 51 salmon/sea trout were seen using this route. The numbers of salmon caught on rod and line, which have to be reported by anglers by law, are collated by the Agency. Since 1996, basic data on the composition of the smolt run has been obtained through netting surveys of the final pool of the canoe slalom. Surveys using a beam trawl throughout the estuary and the cooling water intake at the power station in the lower Tees have occasionally recorded salmonids.

The number of returning salmonids trapped at the Tees Barrage are shown below in Tables 3 and 4 and illustrated in Figure 3. It should be noted that considerable numbers of fish pass over the

Fig. 3. Salmon and Sea Trout trapped at the Tees Barrage





gates of the barrage during periods of elevated river flow - therefore, the total migratory salmonid run into the Tees could be in the order of several thousand fish.

Table 3. Numbers of Salmon Trapped at the Tees Barrage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1995	--	--	--	--	6	0	1	2	0	31	47	0	87
1996	5	2	2	3	6	4	1	0	0	42	32	1	98
1997	0	2	1	0	3	12	23	2	12	18	40	12	125
1998	0	0	1	8	0	34	29	24	32	92	20	3	240

Table 4. Numbers of Sea Trout Trapped at the Tees Barrage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1995	--	--	--	--	13	5	1	1	2	101	41	0	164
1996	4	0	0	1	1	0	0	0	0	92	29	9	136
1997	1	1	3	0	1	0	19	1	13	22	92	47	200
1998	2	1	1	2	1	10	25	16	25	141	54	18	278

The number of salmonids caught by rod in the freshwater reaches of the Tees River are shown below in Table 5. The number of rod caught sea trout are consistently lower than those for salmon. This is a reflection of the degree of effort expended fishing for the two species.

Table 5. Numbers of Reported Rod Caught Salmon and Sea Trout (1987 - 1997)

Year	Salmon	Sea trout
1987	18	0
1988	11	3
1989	3	0
1990	3	1
1991	1	0
1992	11	4
1993	14	0
1994	38	2
1995	100	17
1996	26	16
1997	27	12

The number of smolts netted at the barrage are shown below in Table 6. The ratios of salmon smolt and sea trout smolt are very different to the ratios of adult fish from the trap. This could be because the fish pass may favour the passage of sea trout while salmon may prefer to pass via the gates.

Table 6. Numbers of Smolts Netted at the Tees Barrage (1996 - 1998)

Year	Salmon	Sea trout
1996*	242	15
1997#	348	29
1998+	594	167

Key: * = single sample
= Total of 5 samples
+ = Total of 6 samples

The data collected from other fish surveys in the Tees Estuary is given below in Table 7. Beam trawling is not generally suited to fishing for salmonids and the lack of data is not surprising.

Table 7. Salmonids Recorded from Estuarine Fish Surveys (1995-98)

Source/Survey	Date	Abundance
Power station	December 1995	1
Power station	May 1997	1
Power station	August 1997	1
Power station	August 1998	1

The conclusions are as follows:

Table 8. Current State of the Tees Estuary Salmonid Returns

Stretch	Objective	Indicators	Current State
Barrage to Teesport	Encourage and maintain the passage of salmon and migratory sea trout smolts to sea during migration period and returning adults at all times	Recorded presence of returning adult salmon and sea trout in the Tees barrage fish trap	Successful passage of smolts during spring. Passage of adults year round, influenced by river flow.
Teesport to Gares	Encourage and maintain the passage of salmon and migratory sea trout smolts to sea during migration period and returning adults at all times	Recorded presence of returning adult salmon and sea trout in the Tees barrage fish trap Recorded presence of salmonids at the Hartlepool Power Station cooling water intake screens	Successful passage of smolts during spring. Passage of adults year round, influenced by river flow. Presence of sea trout in low numbers at varying months of the years.

Eels

The objective is to encourage and maintain the passage of eels to and from sea during migration periods.

The eel (*Anguilla anguilla)* probably forms one of the major components of fish biomass in the Tees, although it is not possible to obtain accurate figures. Although elvers and adult eels are able to tolerate poorer water quality than species such as salmon and sea trout, long reaches of poor quality water in estuaries are a barrier to migration. The improvements made to the Tees Estuary, primarily for the benefit of migratory salmonids, have therefore also benefited the eel population. Elvers arrive at the estuary in early May and the migration period extends through to August.

As part of the barrage construction, an elver pass was installed within the fish pass channel. The pass was subsequently adapted so that a detailed study of elvers could be carried out. Continuous water temperature data and data on river flows were obtained to investigate relationships between these parameters and elver migration. Sampling of the elver run was undertaken on 11 occasions in 1996. Surveys using a beam trawl throughout the estuary and the cooling water intake at the power station in the lower Tees have occasionally recorded adult eels.

The catch data from the elver pass at the barrage is given below in Table 9. The monitoring has shown that elvers are able to migrate upstream past the barrage using the elver pass. There does not appear to be any clear relationship between migration and environmental factors such as water temperature and river discharge.

Table 9. Catch Data from the Elver Pass

Date	Number caught	Mean length (cm)	Mean weight (g)
13.05.96	9	7.0	0.22
15.05.96	8	7.1	0.22
20.05.96	47	7.2	0.28
29.05.96	143	6.9	0.31
04.06.96	276*	7.2	0.26
14.06.96	288*	7.1	0.27
25.06.96	256*	6.9	0.27
05.07.96	210*	7.0	0.28
18.07.96	61	6.7	0.39
29.07.96	107	7.1	0.38
07.08.96	50	7.1	0.42

Key: * = sub sample

The conclusions are as follows:

Table 10. Current State of the Tees Estuary Eel Returns

Stretch	**Objective**	**Indicators**	**Current State**
Barrage to Teesport	Encourage and maintain the passage of eels to and from sea during migration periods	Recorded presence of eels at the Tees Barrage during migration periods	Successful passage during spring and autumn.
Teesport to Gares	Encourage and maintain the passage of eels to and from sea during migration periods	Recorded presence of eels at the Tees Barrage during migration periods. Recorded presence of eels at the Hartlepool Power Station cooling water intake screens	Successful passage during spring and autumn. Present in July 1995 and 1997.

Lampreys

The objective is to encourage and maintain the passage of lampreys to and from sea during migration periods.

Three species of lamprey are found in the Tees catchment, the brook lamprey (*Lampetra planeri)*, the river lamprey (*Lampetra fluviatilis)* and the sea lamprey (*Petromyzon marinus)*, although only the last two are migratory. Sea lampreys migrate into rivers to spawn from April to July and the larvae spend up to seven years in fresh water before making the journey to sea. Throughout Western Europe, numbers of sea lamprey have declined due to pollution and obstructions to spawning grounds and this decline has been evident on the Tees, with no reported sightings for most of the 20th century. However, following improvements to the water quality in the estuary, they have been recorded at the barrage in 1996, 1997 and 1998. River lamprey have a similar life history to the sea lamprey, migrating into the Tees during spring and early summer.

There are no formal monitoring programmes to target either sea or river lamprey and the only records are those obtained from the barrage or from occasional encounters during routine fisheries surveys.

Several sea lamprey were observed using the barrage's fish pass during 1996 and 1997, but were able to pass through the trap. From May to July 1998, 20 were caught in the trap. Small numbers of river lamprey were caught in 1995 during routine fish population surveys of the middle reaches of the Tees and they have also been encountered in the power station surveys.

The conclusions are as follows:

Table 11. Current State of Returning Lampreys in the Tees Estuary

Stretch	Objective	Indicators	Current State
Barrage to Teesport	Encourage and maintain the passage of lampreys to and from sea during migration periods	Recorded presence of lampreys at the Tees Barrage during migration periods	Successful passage of Sea Lampreys observed at the barrage during 1996,97 and 1998.
Teesport to Gares	Encourage and maintain the passage of lampreys to and from sea during migration periods	Recorded presence of lampreys at the Tees Barrage during migration periods Recorded presence of lampreys at the Hartlepool Power Station cooling water intake screens	Successful passage of Sea Lampreys observed at the barrage during 1996,97 and 1998. River lamprey encountered only - A single record from 1995.

Estuarine fish

The objective is to encourage and maintain and healthy estuarine fish population that is consistent with the hydro-physical regime.

Estuaries are important as nursery and feeding areas for juvenile fish as well as supporting a number of resident species. In general, fish found in estuaries fall into the following categories:

- estuarine resident, such as three-spined stickleback and sand goby
- estuarine dependant, such as flounder and viviparous blenny
- marine visitors, such as cod and whiting
- freshwater, such as dace
- migratory, such as salmon and eel.

Deep-water fish surveillance has been undertaken in the Tees Estuary since 1981. In 1991, surveillance began using the cooling water intakes at Hartlepool Power Station to monitor fish populations. This provided an efficient method of obtaining body burden samples from a variety of fish species for ongoing Titanium Dioxide Directive studies. The work was later used to meet the requirements of a monitoring programme which required a study of sprat and herring populations and body burden data. More recent surveys provided information on body burdens in flatfish.

Surveys using a beam trawl are carried out within three, four-month periods. The surveys focus on six sites between the Gares and the barrage and there are three replicate tows at each site. Salinity, pH, dissolved oxygen and temperature measurements are taken at the end of each tow and fish and megabenthos are identified and enumerated at each site. Samples of fish are kept for body burden analyses. The monitoring of the power station cooling water intakes takes place over a six-hour cycle and survey frequency is usually once a month. Samples are collected in frame nets, which are emptied every 30 minutes and immediately replaced while the catch is assessed.

In general, the lower three reaches support a more diverse fish fauna than the upper estuarine sites. This is not unusual in a situation of increasing stress with distance upriver. However, the frequent absence of any fish species in the upper estuarine reaches can be attributed to the prevalence of low dissolved oxygen throughout the year.

The difference in spatial distribution of fish species is seen by the presence of more marine visitors such as plaice *(Pleuronectes platessa)* in the lower estuary sites leading to a greater diversity of species. In the middle and upper reaches, up towards the barrage, a more restricted fish fauna with fewer marine species is found. The freshwater influence of the original upper estuary sites above the barrage was demonstrated by the dominance of freshwater fish species, as well as flounder. The formation of the barrage will have effected the distribution and abundance of these fish.

The number of estuarine fish species remains more or less constant over the 1995 to 1997 period. There is a little more variation in the total number of fish species caught over the same period as a result of occasional records of marine species. The species list at the power station is typically higher than the lower estuary trawl sites. This arises from the less specific sampling technique and the greater number of sampling periods throughout the year. The samples collected are dominated by mid-water fish (96% small sprat and herring). Juveniles are particularly susceptible to entrainment as well as the less mobile fish species. The Greatham Creek area is less disturbed and more protected than the main channel, which makes it an ideal habitat for these groups of fish.

In 1996, the number of fish (not the number of species) from trawl surveys in the Tyne, Wear and Tees had declined from the previous year. This was not attributed to a change in sampling technique as it was mirrored in the screen catches from Hartlepool Power Station. Therefore, this decline may be considered a regional event rather than a result of a local change in habitat quality. This may be a result of lower recruitment in East Coast fish stocks.

It is worth noting that upstream of the barrage there has been an increase in abundance of all freshwater fish.

During the power station intake surveys, concentrations of a number of determinands - both organic and metallic - are obtained from sprat and flounder. Results are compared against Ministry for Agriculture, Fisheries and Food guideline values. From this comparison, a number of determinands are shown to be greater than the 'clean' values. Regular exceedences are obtained for zinc, lead, DDE, TDE, PCB's and HCB. PCB exceedences in this table are likely to be lower than the true values, as many more PCB congeners exist and are not monitored on a regular basis. The PCB exceedences are primarily within the "high" guideline levels. Occasional exceedences occur with dieldrin, DDT and cadmium (single exceedence).

The conclusions are as follows:

Table 12. Current State of Estuarine Fish Populations in the Tees Estuary

Stretch	Objective	Indicators	Current State
Barrage to Teesport	Encourage and maintain a healthy estuarine fish population that is consistent with the hydro-physical regime	Recorded presence of flounder at all suitable trawl sites during summer and winter trawl survey Recorded presence of one other estuarine species at trawl sites during year For selected species of fish, body burdens of specific substances in lower category of MAFF guidelines	Poor. Absence of flounder at most times of the year and at many sites. 3 out of 6 seasons for Smith Dock, 2 out of 9 BB, 1 out of 9 for PK from 1995-97. *No data is available for this stretch.*
Teesport to Gares	Encourage and maintain a healthy estuarine fish population that is consistent with the hydro-physical regime	Recorded presence of flounder at trawl sites during summer and winter trawl survey Recorded presence of 2 or more other fish species at all sites throughout the year For selected species of fish body burdens of specific substances in lower category of MAFF guidelines	Poor. Absence of flounder at many times of the year at many sites. Exceeds target for power station site. Presence of one or more estuarine fish at 5 out of 9 seasons for GY, 4 for WI & 4 for QE over the 3 years. Regular high levels in some determinands - Zn, Pb, DDE, TDE, PCBs and HCB. Occasional high levels in Cd, DDT and dieldrin.

N.B.Trawl sites from Gares to Queen Elizabeth jetty (QE) were considered as within lower reach of estuary, despite the fact that QE site crosses to upriver side of Teesport.

Waterfowl

The objective is to maintain levels of waterfowl usage that contribute to the internationally and nationally important waterfowl populations of the Teesmouth and Cleveland Coast SPA/RAMSAR site.

All intertidal habitats of significance for the Tees Estuary's waterfowl now receive protection from statutory designations. With the exception of teal, all waterfowl species listed in the SPA and RAMSAR Citations are largely dependent on such habitats. The degree of this dependence varies from total (in the case of Shelduck) through partial (in the case of Redshank) to limited (in the case of Sanderling in winter). These species, and the seasons in which they occur, are listed in Table 13. All populations listed depend to a varied extent on the area covered by this report. Figure 2.2 illustrates the most significant roosting and feeding sites in and around the Tees Estuary.

Table 13. Specified Limits for Species of Nature Conservation Interest (data from EN)

Feature	Present Status	Lower Limit	Trend
Knot(winter)	3574	2000	Stable
Redshank (autumn)	1648	1000	Increase
Redshank (winter)	1142	500	Stable
Shelduck (winter)	1294	1000	Stable
Sanderling (winter)	189	150	Decline
Sanderling (spring)	447	300	Stable
Ringed Plover (spring)	354	300	Increase
Sandwich Tern (autumn)	1901	1000	Stable

The Wetland Bird Survey (WeBS) is a long-established and highly respected national monitoring scheme for the UK's non-breeding waterfowl populations and the Tees Wetland Bird Survey site is part of the project. The site comprises 22 separate sectors divided up between five sub-sites and counted by a team of up to 11 amateur ornithologists every month. It should be noted that only a small proportion of the site falls within the barrage to Teesport area.

Of the eight populations featured in Table 13, only the Redshank in autumn and winter and the Shelduck in winter have any significant dependence on the barrage to Teesport area. However, all eight populations exhibit some dependence on the Teesport to Gares area.

The conclusions are as follows:

Table 14. Current State of Wading Bird Populations in the Tees Estuary

Stretch	Objective	Indicators	Current State
Barrage to Teesport	Maintain levels of waterfowl usage which contribute to the internationally and nationally important waterfowl populations of the Teesmouth and Cleveland Coast SPA/RAMSAR site	% area of rich intertidal biotope maintained % cover and thickness of *Enteromorpha* (macroalgae) Annual comparisons with five-year mean peak populations of species maintained within specified limits (see Table 1.4 for species and numbers)	There has been no reclamation of intertidal habitat during the period 1995 to 1997. Enteromorpha is not currently found to any great extent in this stretch of the estuary. WeBS data does not provide sufficient information for conclusions to be drawn regarding Barrage to Teesport area. Data from the North Tees mudflat will be used to generate indicators in the future.
Teesport to Gares	Maintain levels of waterfowl usage which contribute to the internationally and nationally important waterfowl populations of the Teesmouth and Cleveland Coast SPA/RAMSAR site	% area of rich intertidal biotope maintained % cover and thickness of *Enteromorpha* (macroalgae) Annual comparisons with five-year mean peak populations of species maintained within specified limits (see Table 1.4 for species and numbers)	There has been no reclamation of intertidal habitat during the period 1995 to 1997. The increasingly sandy nature of Seal Sands gives cause for concern. Increasing growth of *Enteromorpha* at Seal Sands gives cause for concern. All species maintained at levels above lower specified limits. Winter Shelduck and possibly autumn Redshank populations giving cause for concern.

Benthic Fauna

The objective is to encourage and maintain a healthy benthic fauna that is consistent with the hydro-physical regime.

Benthic fauna - species living on the estuary bed - are vital components of the estuary food chain. Estuaries are naturally organically enriched due to the deposition of land-derived organic matter as the river meets the sea. This material and its breakdown products provide the primary food source for deposit-feeding animals in estuarine sediments. This in turn leads to an abundant food source for estuarine fish and, in the intertidal zone, for waterfowl. The natural stress in an estuary imposed by fluctuating salinities serves to reduce the diversity of animals that can inhabit estuarine sediments. As a result of this, estuaries are characterised by abundant populations of relatively few species. The Tees Estuary is no exception.
In an unpolluted state an estuary shows a gradient of reducing diversity towards the upper reaches.

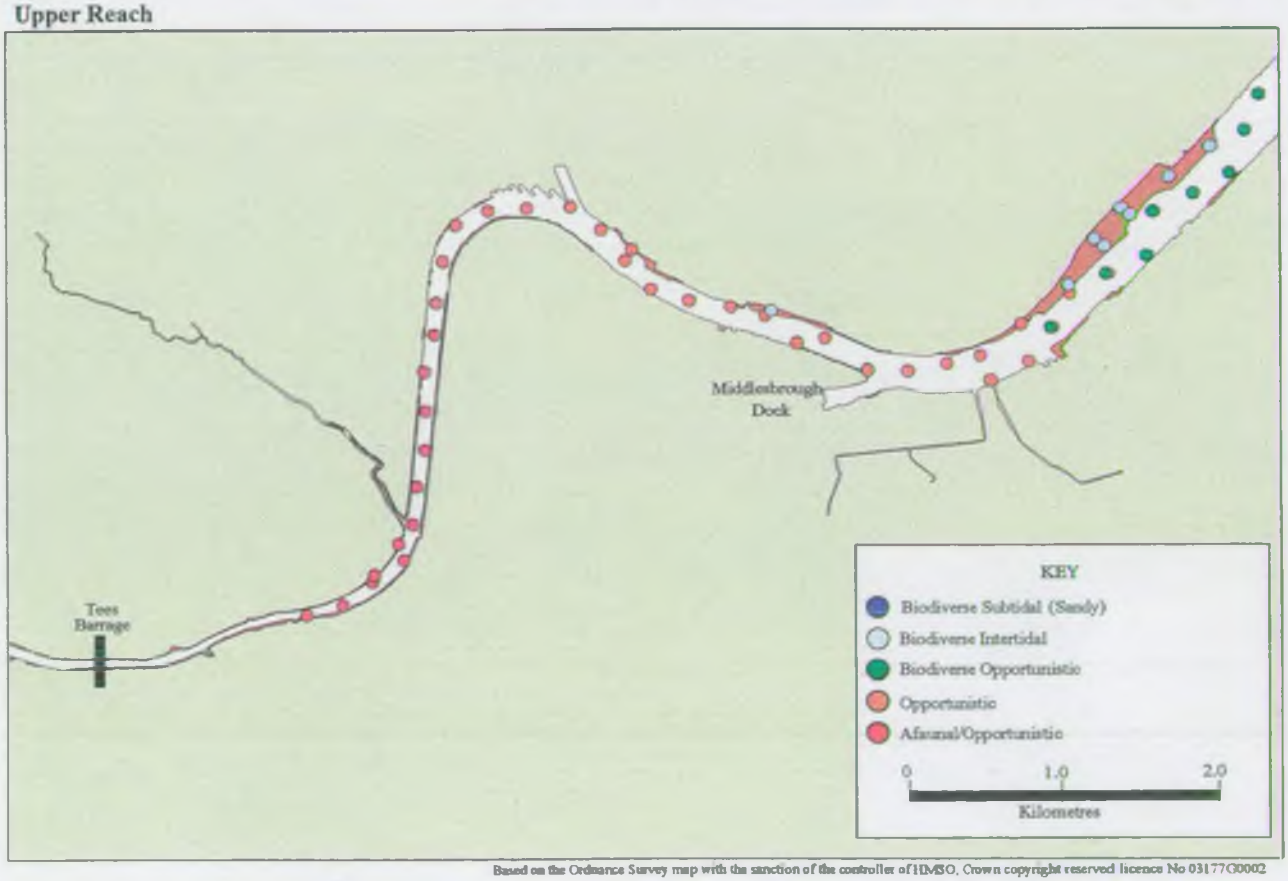
This natural balance can be disrupted directly or indirectly, by a variety of human influences including physical impacts due to dredging and contamination from various sources such as sewage and industrial effluents. The benthic fauna of estuaries subjected to high levels of human disturbance will be characterised more by biotopes that are indicative of such disturbance. In extreme cases, parts of the estuary may show features that are more typically associated with the stressed upper reaches. Thus knowledge of the distribution of the benthic faunal biotopes and the species found provides a basis for assessing the state of the estuarine environment.

During 1995 and 1996, a total of 112 sites were sampled to assess the benthic fauna of the Tees Estuary both subtidally and intertidally. The biotopes encountered were then categorised according to the degree of stress exhibited.

Figure 4, shows the distribution of sites. Subtidal sites were sited along the length of the estuary at approximately 250m intervals. Intertidal sites were chosen as representative of a particular area of intertidal shore. All samples were preserved and the animals were extracted in the laboratory,

Fig. 4 1995/96 Classification of macroinvertebrate biotopes

Upper Reach



identified and enumerated using standard methods. The resulting dataset was subjected to a variety of statistical techniques in order to describe and characterise the biotopes encountered. Samples of cockles and mussels were taken from various sites.

Benthic macrofauna are the animals living within the soft sediments of the estuary bed intertidally and subtidally. Since most benthic organisms are effectively sessile (remain in the same locality), they act as reliable indicators of spatial variations in environmental stress, they may also live for 1 – 10 years or more and therefore act as integrators of short to medium term changes in environmental stress; whether the stresses are natural, like salinity changes, or due to pollutants. Benthic organisms ultimately rely on the overlying water column for food and oxygen and are therefore useful indicators of the overlying water quality. Benthic communities have long been utilised as a measure of environmental quality.

Benthic communities support the thriving wading bird populations in the Teesmouth Nature Reserve and SPA and at the Teesport mudflats (SSSI). The estuary also supports a significant biomass of invertebrates in the middle reaches around Middlesborough Dock upstream to the Transporter Bridge. The diversity of species, however, is significantly depressed in this stretch of the estuary. This can primarily be attributed to organic pollution of the sediments and historically low dissolved oxygen levels. The communities present are typified by pollution tolerant worms in very high abundance with very few other species being represented.

An extensive survey in 1995 and 1996 provided a base line against which future changes could be monitored. Sites were grouped according to the similarity of their fauna and were proportioned to descriptive categories according to their status. They are shown below.

Table 15. Classification of Benthic Communities from Sites Surveyed in 1995/96

Biotope	No. Sites	% of the total
Abiotic\opportunistic	12	11
Opportunistic	26	24
Diverse opportunistic	35	32
Biodiverse intertidal	29	26
Biodiverse subtidal (sandy)	8	7

All sites surveyed for cockles were at Seal Sands. The results show that there is a substantial population of cockles on the sands, but that it is not characterised by the very high densities in exploitable cockle populations. The number of year classes found is low compared to studies carried out elsewhere. The results of mussel surveys suggest a general increase of metal body burden in mussel tissues at Bran Sands. Zinc, lead and arsenic reach high levels. There is a decreasing trend at Hartlepool, with the only exception of arsenic.

The conclusions are as follows:

Table 16. Current State of Macroinvertebrate Communities in the Tees Estuary

Stretch	Objective	Indicators	Current State
Barrage to Teesport	Encourage and maintain a healthy benthic fauna that is consistent with the hydro-physical regime	Reduction in the number of sites surveyed classified as Opportunistic biotope and an increase in the number of sites classified as biodiverse opportunistic biotope	Dominated by biotopes indicative of organic pollution.
Teesport to Gares	Encourage and maintain a healthy benthic fauna and flora that is consistent with the hydro-physical regime	No increase in sites classified as afaunal / opportunistic biotope Maintain number of sites classified as biodiverse subtidal and intertidal Cockles population at Seal Sands classed as "upholding" with numerous age classes Stand-still body burdens of specific substances for mussels	Future assessments will compare with baseline data for 95/96. Future assessments will compare with baseline data for 95/96. Cockles population still in "crisis", no increase in no. of age classes or younger individuals. A general increase in metal burdens in mussels has been found at Bran Sands

Benthic Flora

The objective is to encourage and maintain a healthy benthic flora that is consistent with the hydro-physical regime.

Large algae are very useful indicators of water quality due to their fixed nature and the continual exposure to the water column. As with benthic fauna, the balance of algal species present can give a good indication of the quality of the estuary. Macroalgae, particularly the brown algae *Fucus* is also useful for monitoring the accumulation of certain chemicals in its tissue. Eutrophication of a body of water is the enrichment by nutrients; particularly nitrates, phosphates and silicates. Although it may occur as a natural phenomenon, the majority of cases in estuaries are as a result of influences such as inputs of waste water and drainage from agricultural land. Other contributing factors include the hydrodynamics of the estuary (i.e. how long the nutrients remain in the area) the turbidity and extent of stratification with in the estuary, the form in which the nutrients enter the estuary, and nutrient transformations within the estuarine system. There have been many reports documenting the increase in occurrence of algae associated with eutrophication, mostly related to green algae such as *Enteromorpha.* Excessive growth of such algae may have detrimental effects, particularly on the ecology of intertidal mudflats.

Species lists were compiled from data collected by various sources and explant growth experiments were performed. A Compact Airborne Spectrographic Imager (CASI) has been used to produce images of the Tees Estuary which could be used to assess the extent of the growth of algal mats on the estuary's mudflats. Samples of a macroalgae were collected from two sites and analysed for various metal levels.

Historically, the flora of the estuary has undergone many changes. From 1929 to 1970, fucoids were all but eliminated and the whole mid-section of the estuary was almost devoid of macroalgae. From 1981 onwards, there has been a gradual recolonisation of the mid-reach to a

richer state. Table 17 below shows the inner limit of fucoids moving further up the estuary with time.

Table 17. Geographical Limits of Fucoid Algae in the Tees Estuary

Date	**Inner limit of fucoid algae**
1929	Preston Park, upstream of Stockton, absent at Riverside Park.
1970	British Steel, Redcar - close to the estuary mouth
1991	No change from 1970
1993	Cargo Fleet – advancing into the estuary
1995	Transporter Bridge - further upstream
1998	Riverside Park – advance continues

The present distribution of algal species indicates a gradual transition with increasing distance towards the open sea, which is a typical estuarine distribution. In 1986, no *enteromorpha* algae was reported to be present on Seal Sands. But by 1997, 37 per cent of the intertidal mudflat area was covered, mostly by dense mats (see Table 18 below).

Table 18. Aerial Cover of the Macroalgae, Enteromorpha, *Intertidally at Seal Sands*

Areal cover of algal mat as a % of total area of intertidal mudflat	Cover Type	June 1992	June 1996	Sept 1996	Sept 1997
	Sparse	*	6.4%	9.2%	3.5%
	Dense	*	7.8%	22.0%	33.3%
	Total	11.3%	14.2%	31.2%	36.9%

With regard to tissue burdens of specific substances in the macroalgae *fucus*, metal concentrations are shown below in Table 19. The areas covered are Greatham Creek and Bran Sands.

Table 19. Tissue Burdens of Specific Substances in the Macroalgae, Fucus spp. *(mg/kg dry weight)*

Site	GC	BS	GC	BS	GC	BS	GC	BS
Year	1995		1996		1997		1998	
Substance								
Copper	13.6	20.7	19.0	17.6	12.4	13.6	11.6	21.9
Cadmium	0.52	0.5	0.6	0.7	0.46	0.57	0.39	0.61
Zinc	226	110.0	180	126	167	153	172	164
Total Mercury	0.1	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	0.056
Lead	8.73	8.94	ND	ND	4.89	3.24	3.06	8.07
Arsenic	8.3	13.2	23.2	40.1	20.7	22.7	18.1	33.7
Nickel	<10	<10	10.0	<10	<10	14.5	<10	<10

GC = Greatham Creek
BS = Bran Sands

The conclusions are as follows:

Table 20. Current State of Benthic Flora in the Tees Estuary

Stretch	Objective	Indicators	Current State
Barrage to Teesport	Encourage and maintain a healthy benthic flora that is consistent with the hydro-physical regime	Increase in number of algal species % cover and thickness of *Enteromorpha* (macroalgae)	Fucoids advanced upstream to Riverside Park in 1998. No areas decreased in species richness overall since 1994. No *Enteromorpha* mats in this stretch.
Teesport to Gares	Encourage and maintain a healthy benthic flora that is consistent with the hydro-physical regime	Increase in number of algal species The growth of the macroalgae, *Enteromorpha* does not exceed 25% coverage of the intertidal mudflats at Seal Sands Stand-still burdens of specific substances for the macroalgae *Fucus*	Species totals show gradual estuarine transition downstream, partially interupted by the Wilton outfall. No decrease in numbers since 1994. The *Enteromorpha* in September 1996 and 97 covered a total area of >30% of the mudflat area at Seal Sands. Initial observations in 1998 suggest that this has not decreased substantially. Increases in Zinc and Arsenic over recent years, otherwise stand-still maintained in other metals.

Aesthetics

The objective is to encourage and maintain the aesthetic quality such that pollution does not affect estuary usage or cause a public nuisance.

Aesthetic quality is an important indicator of the state of the environment, particularly to the general public. The visual appearance of the Tees Estuary offers many contrasts: flat expanses of reclaimed land occupied by the dramatic shapes of industry; jewels of wildlife habitat designated as locally, nationally and internationally important; archaeological features of historic and industrial heritage. Views of the Tees Estuary and the North Sea from the North and South Gares have been recognised by the local planning authority by the inclusion of South Gare in a designated Special Landscape Area.

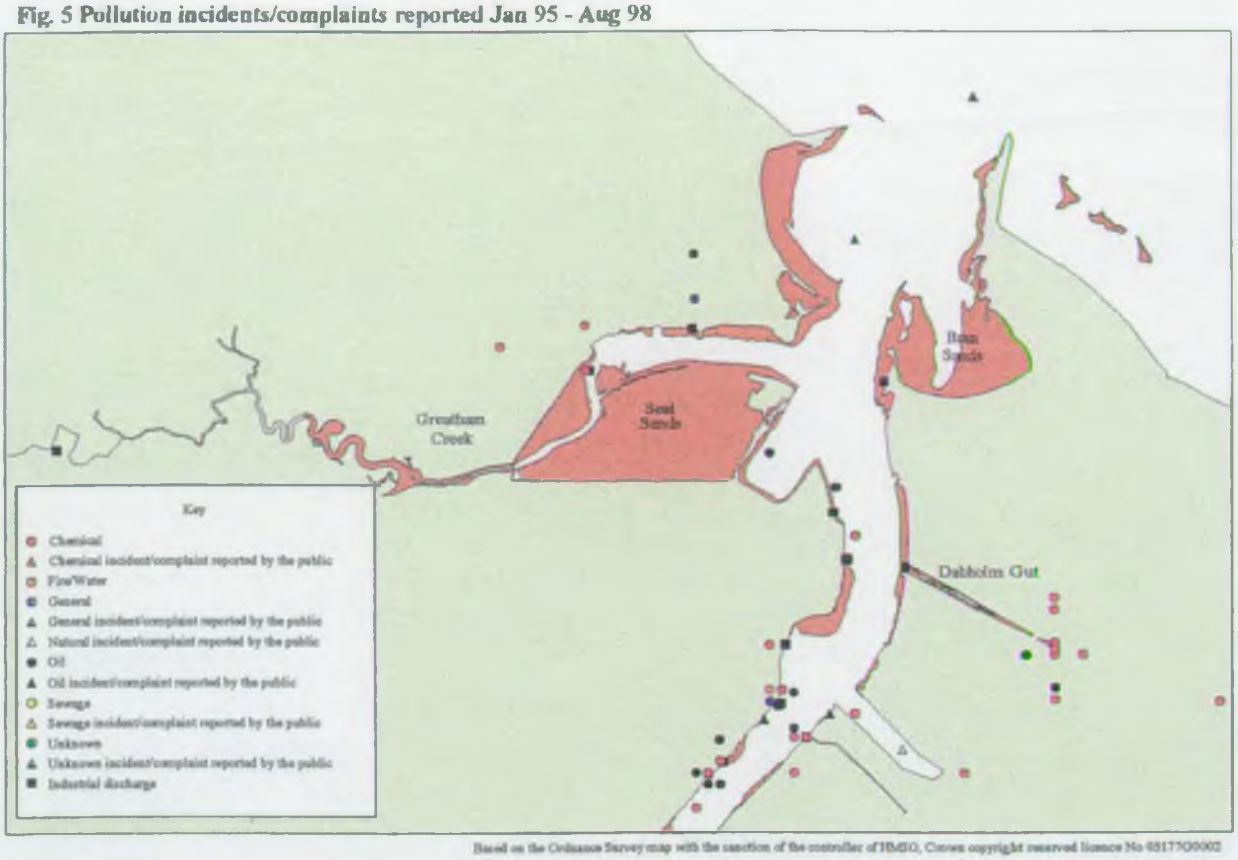
Measuring the aesthetic quality of a landscape is very subjective. Much of the Tees Estuary and estuary frontage is inaccessible to people for safety or environmental reasons. This presents a problem to the process of measuring peoples perception of the aesthetic quality of the whole estuary.

Litter, oil and sewage-derived debris affect the aesthetic quality of a river environment and can attract public attention. The Environment Agency maintains a database of pollution incidents and complaints which are reported to it. Pollution incidents are categorised as 1, 2, 3 or 4 - 1 being a major incident and 4 being unsubstantiated. Tees Estuary pollution incidents and complaints from January 1995 to August 1998 are shown below and in Figure 5.

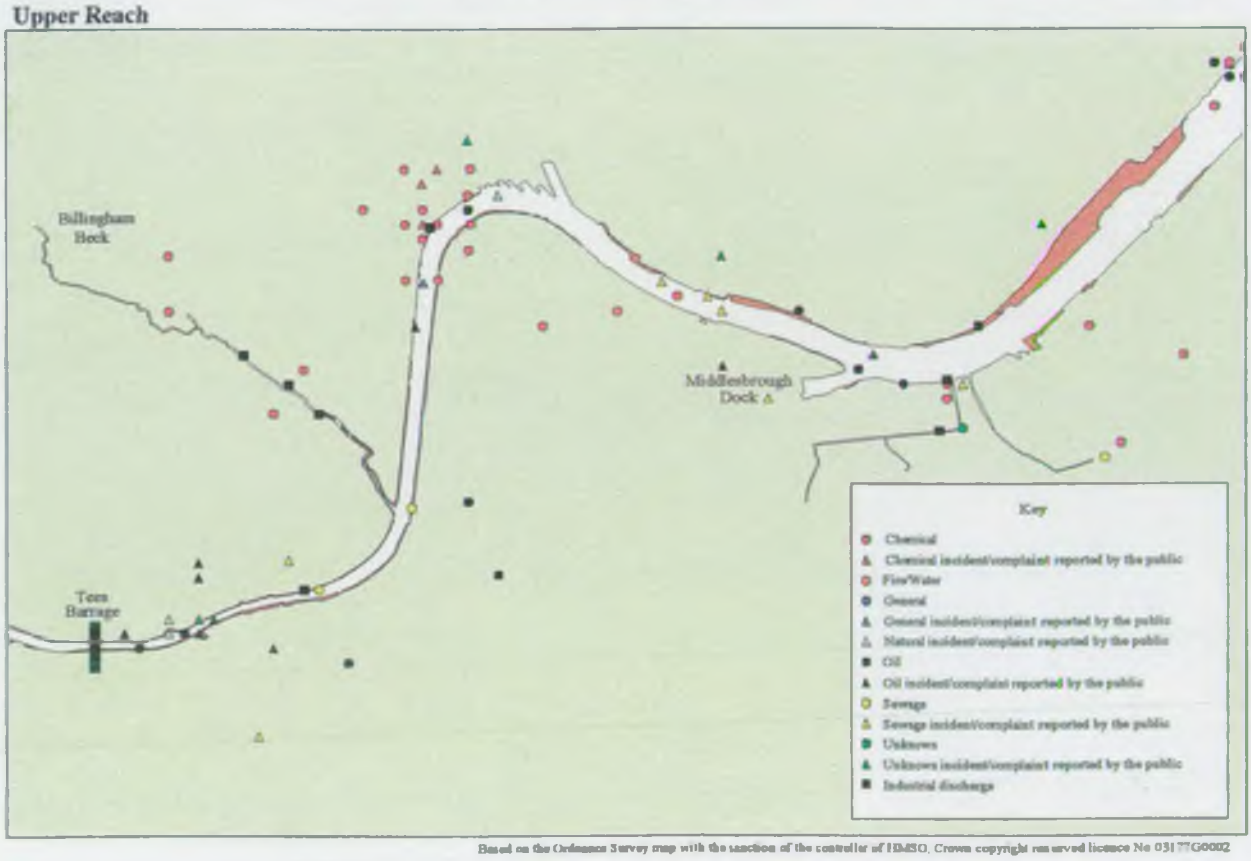
Table 21. Pollution Incidents/Complaints Reported Jan 1995 - Aug 1998

Incident type	No. of reports	Public reports	Category 1	Category 2	Category 3	Category 4
Oil	33	13	2	2	20	9
Chemical	49	3	0	2	38	9
Fire water	3	0	0	0	0	3
General	6	3	0	0	4	2
Sewage	11	7	0	0	10	1
Natural	5	4	0	0	2	3
Not known	4	3	0	0	1	2

Fig. 5 Pollution incidents/complaints reported Jan 95 - Aug 98



Upper Reach



The location of most of the incidents and complaints reported to the Agency by the public corresponds to where the public make use of visitor attractions, riverside paths or the water. As water quality improves, more people want to visit or use the estuary. Measures will need to be taken to ensure that increased recreational activity does not jeopardise industrial operations or the value of ecological and archaeological resources. While recognising the need to maintain a balance between different needs, the opinions of estuary visitors and users could be more widely sought and then used to measure the perceived quality of the estuary.

The conclusions are as follows:

Table 22. Current Aesthetic State of the Tees Estuary

Stretch	Target	Current State
Barrage to Teesport	No public complaints regarding the aesthetic quality of the estuary No increase in pollution incidents	Although the Agency is made aware of problems via public reporting complaints and pollution incidents, procedures are needed for obtaining more general public opinion of the state of the estuary.
Teesport to Gares	No public complaints regarding the aesthetic quality of the estuary No increase in pollution incidents	Although the Agency is made aware of problems via public reporting complaints and pollution incidents, procedures are needed for obtaining more general public opinion of the state of the estuary.

WATER QUALITY

Dissolved oxygen

Oxygen is vital for life in the estuary. In water, oxygen is available in a different form to that found in air. It is dissolved into the water either from the air or as a consequence of the photosynthesis of plants In salt water saturated with dissolved oxygen approximately nine parts per million would be available for aquatic life.

The oxygen that is dissolved in the water may be used up in several ways:-

- Estuarine animals or plants may use the oxygen for biological processes. (e.g. respiration)
- Nitrifying bacteria may use the oxygen to oxidise ammonium to produce nitrite and subsequently nitrate in the nitrification process.
- Ammonium $\Rightarrow$ Nitrite Nitrite $\Rightarrow$Nitrate
  $NH_4^+ + 1.5\ O_2 \Rightarrow NO_2^- + H_2O + 2H^+$ $NO_2 + 0.5O_2 \Rightarrow NO_3$
- The oxygen may be used in the decomposition of organic (carbonaceous) material - resulting in the production of carbon dioxide
- Some substances (e.g. sulphides) may combine with the oxygen to make new substances (e.g. sulphates) without biological mediation.

Effluents high in organic content, ammonia or certain inorganic substances discharged into the estuary will lower the oxygen content of the water. Reductions in oxygen levels tend to have more impact in the estuary in warm dry summer months when input of oxygenated freshwater is reduced and temperatures higher. The impact that effluents from industry or sewage works may have on estuarine oxygen levels can be given a value and this is recorded as BOD (Biochemical Oxygen Demand). The composition of effluent discharged into the Tees Estuary has had a high BOD content. This has long been recognised as a problem and much has been done in recent years to reduce the impact of discharges (see Figures 6.1. and 6.2)

Figure 6.1 Average Daily B.O.D. Loads to the Tees Estuary

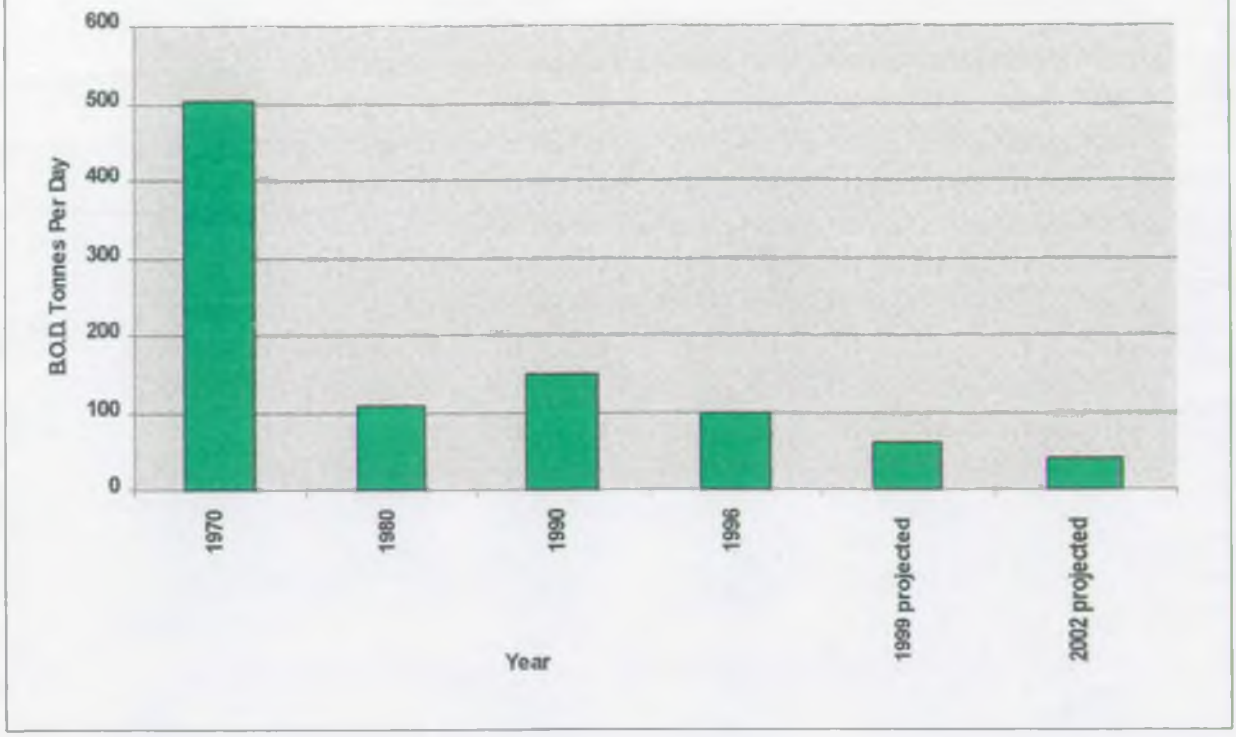
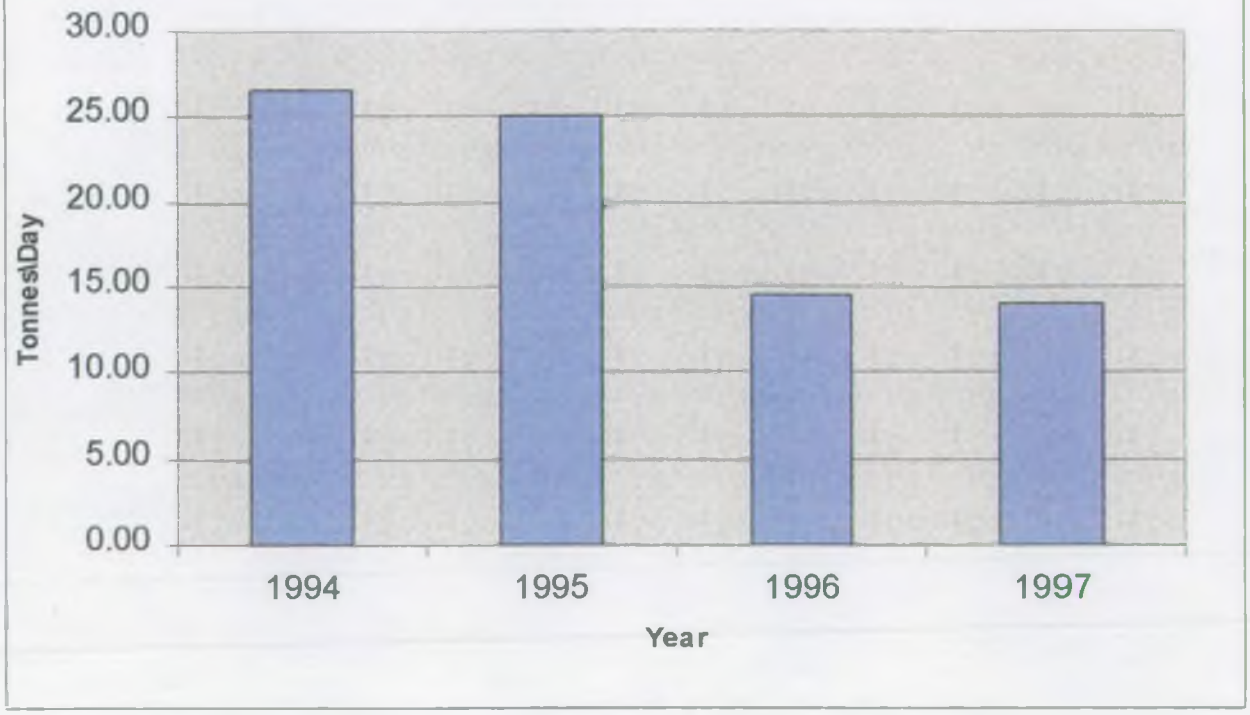


Figure 6.2 Average Daily Load Of Ammonia to the Tees Estuary



Measurements of dissolved oxygen levels are taken *in situ using* multi-parameter probes or dedicated oxygen meters. Oxygen readings are taken at all sites on the Lower Tees Survey (see figure 1) at least 12 times a year. Until 1997, inclusive readings were also taken 5 times a year at a further 18 sites over the estuary at surface, middle and bottom. In 1998, to make up for the shortfall in data, surveys specifically to look at oxygen levels were undertaken. These surveys encompass all lower Tees sites with additional sites in the Billingham Reach area (see Figure 1). The Environment Agency has two fixed monitoring stations on the Tees and both are in the upper part of the estuary. One is sited at Portrack Jetty, the other at Vulcan Street (close to the Transporter Bridge). These have been operational since June 1998. Each station consists of two multi-parameter probes, which are located close to the bottom of the water column, and near the surface - the latter rises and falls with the tide. These instruments collect data (dissolved oxygen, temperature, salinity, turbidity and pH) every 15 minutes. It is possible to access these stations on-line and this allows close monitoring of trends.

The BOD of an effluent is established using standardised laboratory procedures to determine the oxygen requirement of a water sample.

Although little data exists at present regarding the sediment oxygen demand on the Tees Estuary, it is intended to undertake work to establish to what extent this contributes to the overall oxygen demand.

Generally, the levels of dissolved oxygen increases towards the estuary mouth. Levels are normally high above the barrage. Usually, both the relatively dense saline water input from the sea and the freshwater flow over the barrage will have a high dissolved oxygen content. Seasonally dissolved oxygen levels are noticeably higher in winter when temperatures are lower and freshwater flow tends to be high. Annual averages of field observations are shown in Figure 9.1 these show that year-on-year oxygen levels are improving. Figure 9.1 also shows a marked drop in surface oxygen levels in the lower reach of the estuary (Redcar Jetty site) it is thought this is predominantly due to the effluent discharged from Dabholm Gut (Figure 1.)

Fixed monitor data has shown that the depletion of dissolved oxygen levels in the upper estuary is worse when there is a steady, low, freshwater flow input. Plots from the fixed monitor data are shown in Figures 10 and 11 and illustrate oxygen levels against river flow and oxygen levels against temperature.

Dissolved oxygen levels are markedly improving and observations of levels below 20%, which were once common, are now rare. This is mainly due to the substantial decrease in BOD inputs.

It should be remembered that despite these recent improvements there is room for further progress since a period of hot dry weather may result in severe oxygen depletion. More work will be required to evolve a full understanding of this complex system and how different processes may interact or combine to effect the overall picture. This work is vital in order to manage the estuarine environment to meet the Agency's objectives.

The conclusions are as follows:

Table 23. Current State of Dissolved Oxygen Levels.

Stretch	Target	Current State
Barrage to Teesport	Dissolved oxygen of >/= 40% as a 95 percentile (salmon) Surface dissolved oxygen of >/= 30% as a 95 percentile (eels, lampreys) Bottom dissolved oxygen of >/= 45% as a 95 percentile (estuarine fish) Bottom dissolved oxygen of >/= 40% as a 95 percentile (benthic flora and fauna)	24% observed at Portrack Jetty and Old River Tees sites (bottom) 26/8/98 Surface reading 48% at Middlesborough dock. 26/8/98 Lowest daily average readings from fixed stations **Surface** 45% Portrack 18/8/98 30% Vulcan Street 10/7/98 **At Depth** 25% Portrack on 29/8/98 20% Vulcan Street 30/09/98
Teesport to Gares	Dissolved oxygen of >/= 40% as a 95 percentile (salmon) Surface dissolved oxygen of >/= 30% as a 95 percentile (eels, lampreys) Bottom dissolved oxygen of >/= 45% as a 95 percentile (estuarine fish) Bottom dissolved oxygen of >/= 40% as a 95 percentile (benthic flora and fauna)	Lowest bottom reading 58% off Dabholm Gut on 26 August 1998. Lowest Surface reading 62 % off Redcar Jetty 13th July 1998

Ammonia

Ammonia is used extensively in industrial processes. Uses include fertilisers, plastics and explosives. It is also present in sewage effluent and to a lesser extent the riverine input to the Tees Estuary. In most circumstances, ammonia derived from sewage does not reach sufficient concentrations in the estuary to be toxic. But industrial discharges contribute large quantities of ammonia that could be toxic to fish, algae and invertebrates. Ammonia is present at elevated levels throughout the estuary. Its effects on the ecology of the estuary need to be considered in two ways - the problem of toxicity and the fact that ammonia can cause depleted oxygen levels as a result of nitrification. Nitrification is the biological mediation of ionised ammonia NH_4 to nitrite and subsequently nitrate.

Ammonium	$\Rightarrow$ Nitrite	Nitrite	$\Rightarrow$Nitrate
$NH_4^+ + 1.5\ O_2$	$\Rightarrow NO_2^- + H_2O + 2H^+$	$NO_2^- + 0.5\ O_2$	$\Rightarrow NO_3^-$

This process utilises oxygen dissolved in the water column.

The targets referred to in this report are specified as either total ammonia or unionised ammonia.

Samples are taken from the surface, middle and bottom of the water column at all sites visited during the Lower Tees Survey

Ammonia is among those substances identified by the Paris Commission (PARCOM) as requiring monitoring under the 'sources' and samples are therefore regularly taken from the freshwater input to the estuary and at the major discharges to the estuary upstream of any tidal influence. Another survey - the Quinquennial Survey - is carried out every five years. Vessels are stationed at five points in the river (see Figure 1) and at each point water samples are taken from surface, middle and bottom waters. Ammonia is included in the analysis. In 1996 and 1997, surveys were undertaken by Brixham Environmental Laboratory in conjunction with industry and the Environment Agency and focused on the upper stretch of the estuary. The object was to determine the effect of the diversion of the sewage effluent discharge from Portrack sewage treatment works to the Bran Sands complex in the lower reach of the estuary. Following this

Obtaining the data

Coastal survey vessel

Box cover for benthic samples

Processing benthic samples

Laboratory analysis of samples

study, which showed that dissolved oxygen levels were still low despite the diversion of the Portrack effluent, it was decided to investigate possible causes of this oxygen depletion. This study was jointly funded by industry and the Environment Agency and was over and above any statutory requirements.

There are significant inputs of ammonia to the estuary throughout its length. In the upper stretch of the estuary major inputs come from Billingham Beck and RTO1. Portrack Sewage treatment works contributed significantly until its diversion to Bran Sands in 1997. Major inputs in the Lower Estuary come from British Steel South Teesside works (now diverted to Bran Sands), Bran Sands and BASF.

Sources and inputs of ammonia are shown in Figure 8 as identified on the PARCOM (Paris Commission) low load 'hit list'. Total ammonia input to the estuary over recent years as identified by PARCOM returns is shown in Figure 6.2. Annual averages of the spot samples during routine water quality surveys are shown in Figure 7.2. It should be noted that substantial reductions in ammonia output from industry are having a definite beneficial impact on estuarine ammonia levels.

Because of the high variability of ammonia concentrations, spot samples do not necessarily provide a true representation of the average ammonia concentrations over time. It would be desirable to obtain continuous readings. It has been established that nitrification is a significant and measurable phenomena; further work is needed to establish range of nitrification rates and investigate how these are effected by changes in ammonia concentrations either alone or in combination with other factors.

The conclusions are as follows:

Table 24. Current State of Ammonia Levels in the Tees Estuary

Stretch	Target	Current State
Barrage to Teesport	Unionised Ammonia 21 µg/l as a 95 percentile (salmon, eels, lampreys)	Routinely Exceeded
	Total Ammonia 780 µg/l as a 95 percentile (salmon)	Routinely Exceeded
	Surface unionised Ammonia 21 µg/l as a 95 percentile (eels & lampreys)	Routinely Exceeded
	Surface total Ammonia 780 µg/l as a 95 percentile (eels, lampreys)	Routinely Exceeded
	Bottom unionised Ammonia 21 µg/l as a 95 percentile (estuarine fish, benthic flora and fauna)	Routinely Exceeded
	Bottom total Ammonia 780 µg/l as a 95 percentile (estuarine fish, benthic flora and fauna)	Routinely Exceeded
Teesport to Gares	Unionised Ammonia 21 µg/l as a 95 percentile (salmon, eels, lampreys)	Routinely Exceeded
	Total Ammonia 780 µg/l as a 95 percentile (salmon)	Routinely Exceeded
	Surface unionised Ammonia 21 µg/l as a 95 percentile (eels & lampreys)	Routinely Exceeded
	Surface total Ammonia 780 µg/l as a 95 percentile (eels, lampreys)	Routinely Exceeded
	Bottom unionised Ammonia 21 µg/l as a 95 percentile (estuarine fish, benthic flora and fauna)	Routinely Exceeded
	Bottom total Ammonia 780 µg/l as a 95 percentile (estuarine fish, benthic flora and fauna)	Routinely Exceeded

Figure 7.1 Surface Dissolved Oxygen - Annual Averages

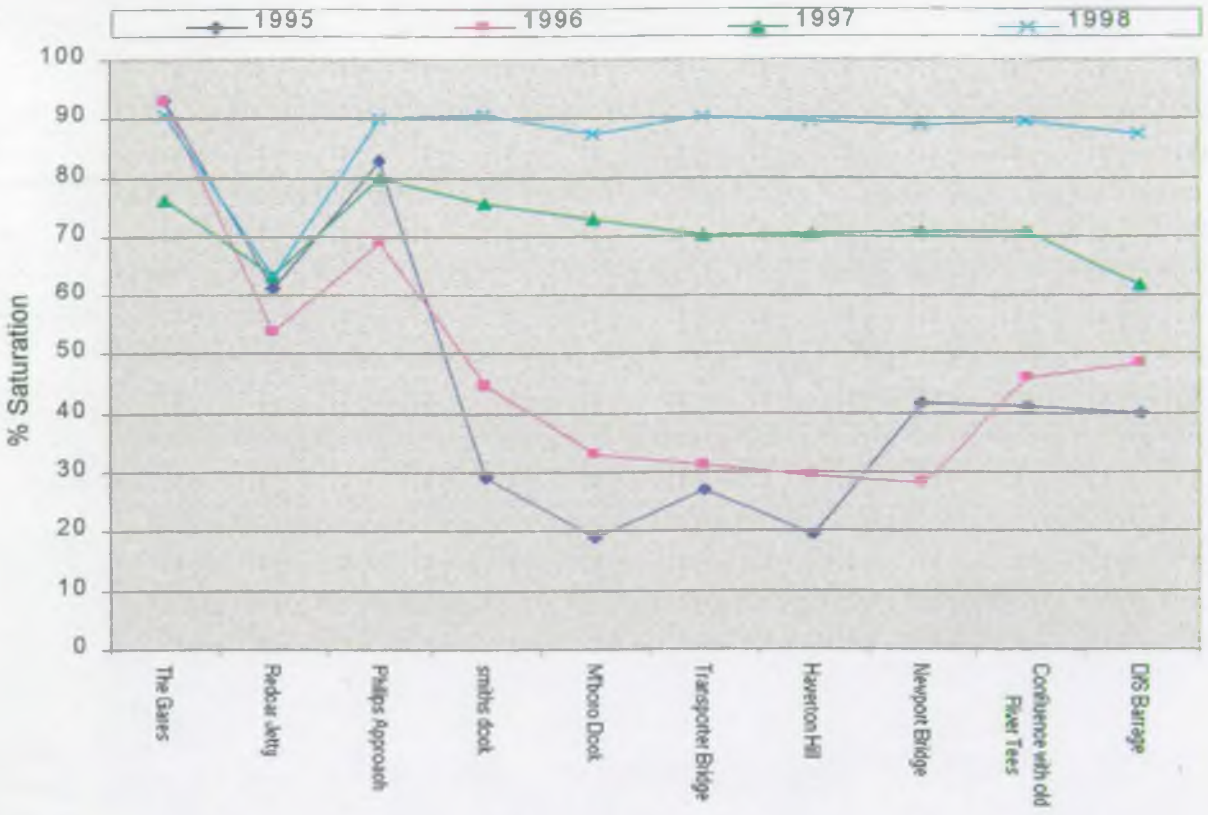


Figure 7.2 Surface Ammoniacal Nitrogen - Annual Averages

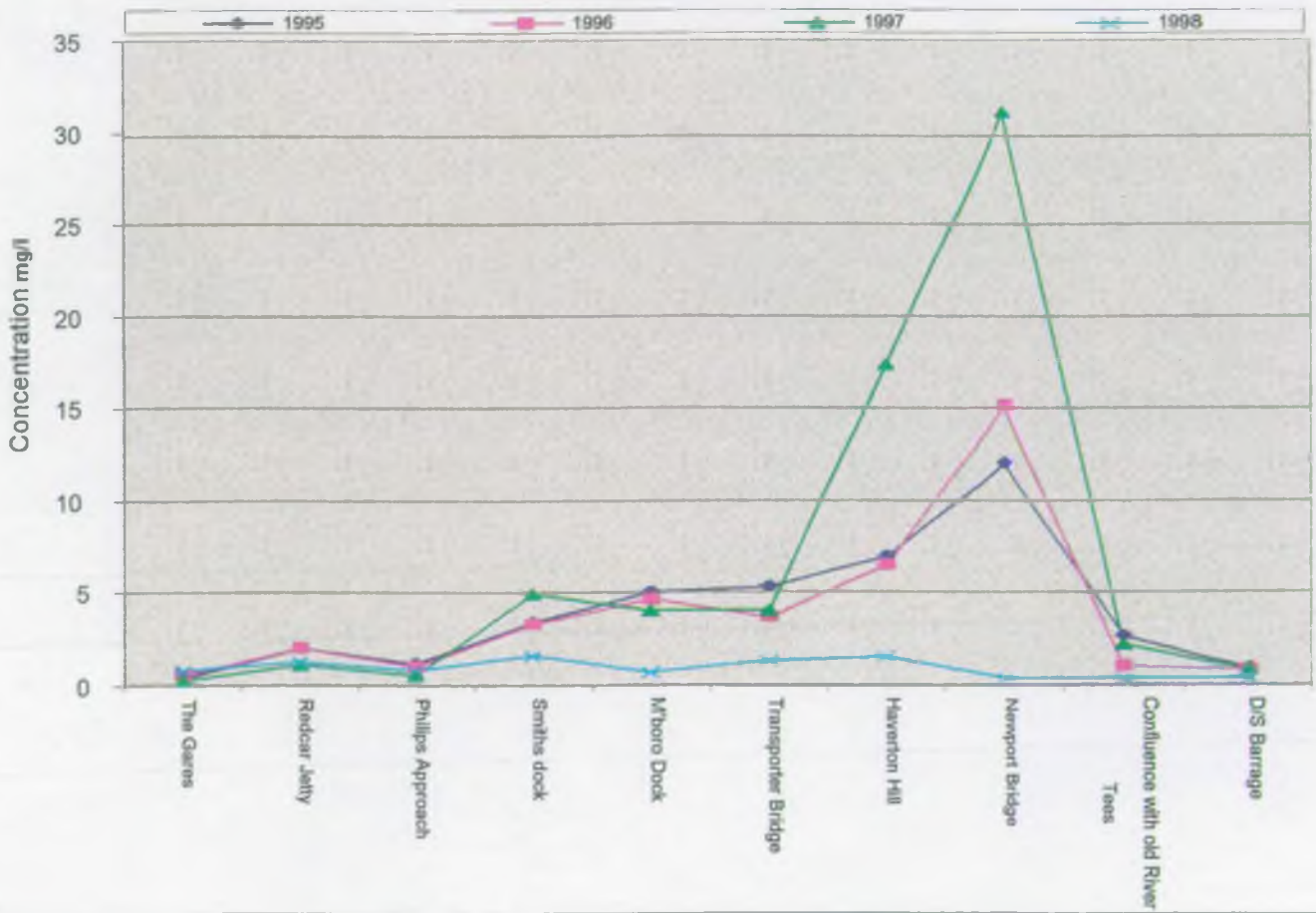
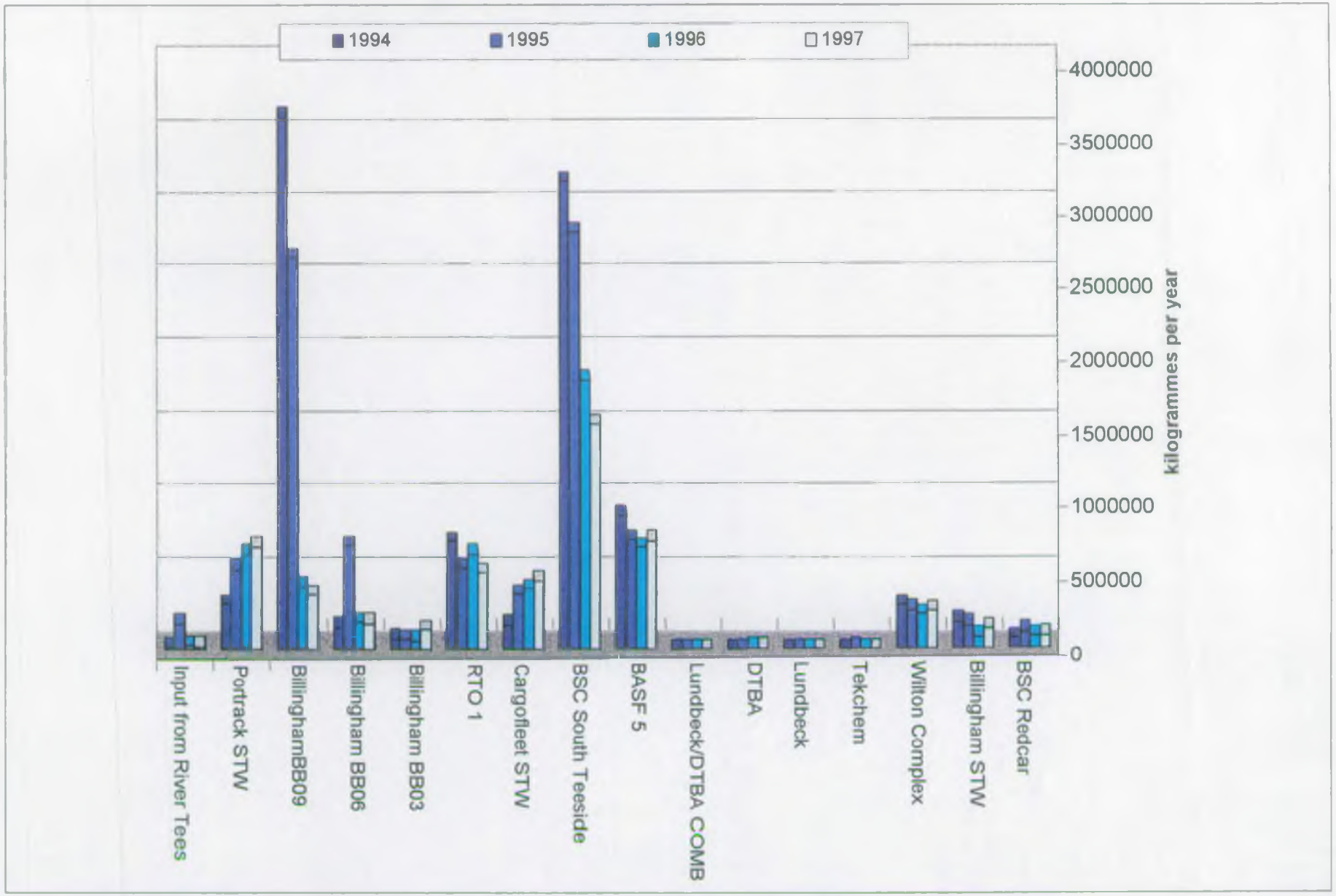


Fig .8. Relative contributions of Ammonia to the Tees Estuary as Identified by PARCOM returns



Nutrients

A nutrient is a substance that provides nourishment. Nitrogen, phosphorous and silica are nutrients which can be found dissolved (or in particulate forms) in estuarine water. Nutrients are subject to continual cycling processes and so can be found in different forms depending on which part of the cycle they have reached. Nitrogen is mainly cycled via biological processes and how it is used varies with variation in the life forms present. Nitrogen is an essential part of the substances that carry genetic information and also of proteins - so all plants and animals have nitrogen atoms as part of their structure. Phosphorous and silica are cycled through physical, chemical and biological processes. Silica is of importance only to very specific organisms called diatoms.

Nutrients can enter the estuary either directly - from industrial or sewage discharges or riverine input - or diffusely in run-off from land. For the Tees Estuary the main impact of run-off will be contained in the riverine input. The sea may also carry nutrients into the estuary with the tide. Recycling of substances within the estuary may also create nutrients by the action of organisms on certain substances.

Problems can occur when the levels of available nutrients rise or fall outside normal levels. The processes involved are complex and the balance between them not yet fully understood. We do know of some specific consequences of nutrient imbalance, in particular eutrophication - the enrichment of waters by inorganic plant nutrients.

The Urban Waste Water Treatment Directive (UWWTD) defines elevated concentrations in estuarine waters as a winter concentration of dissolved inorganic nitrogen of 169µg/l coincident with a dissolved available inorganic phosphorous content of 6.2µg/l.

Surface water samples are taken from all sites visited during the Lower Tees Survey. A quinquennial survey and PARCOM monitoring checks are also carried out.

Figure 9 illustrates the contributions to the estuary of various nutrient sources as identified by PARCOM returns. The riverine input is also included. The most obvious sign of eutrophication

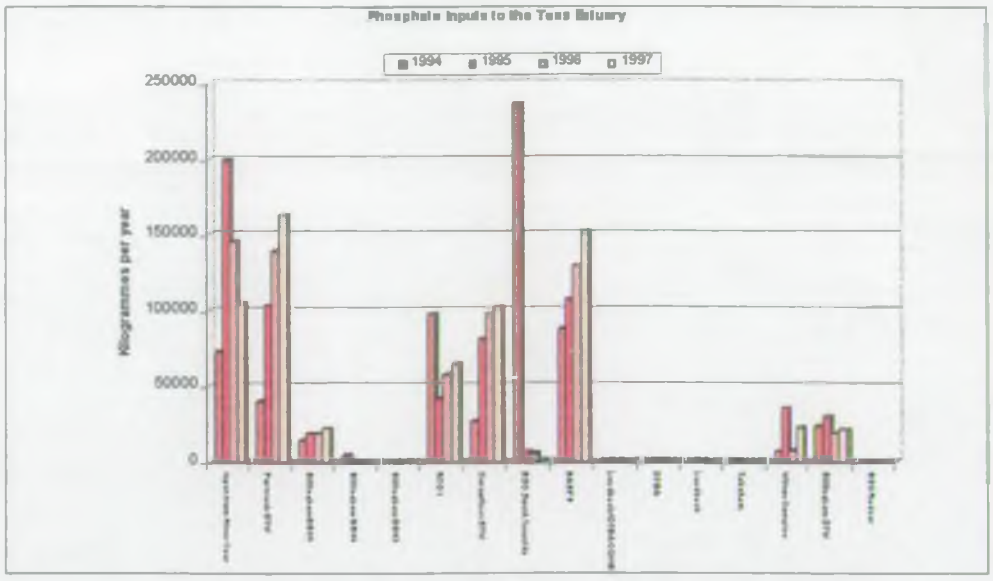
in the Tees Estuary is the presence of macro-algal mats. It is possible that Seal Sands may be designated a 'Sensitive Area to Eutrophication'. This would require discharges to the estuary to be treated to remove nitrogen and/or phosphorous unless it can be shown that removal will have no effect on eutrophication. It can be seen from Figure 9 however, that a substantial proportion of the nitrate input to the estuary is riverine input. The Environment Agency has included the estuary in a three-year monitoring programme to establish if the estuary, or areas of it, should be given Sensitive Area Status.

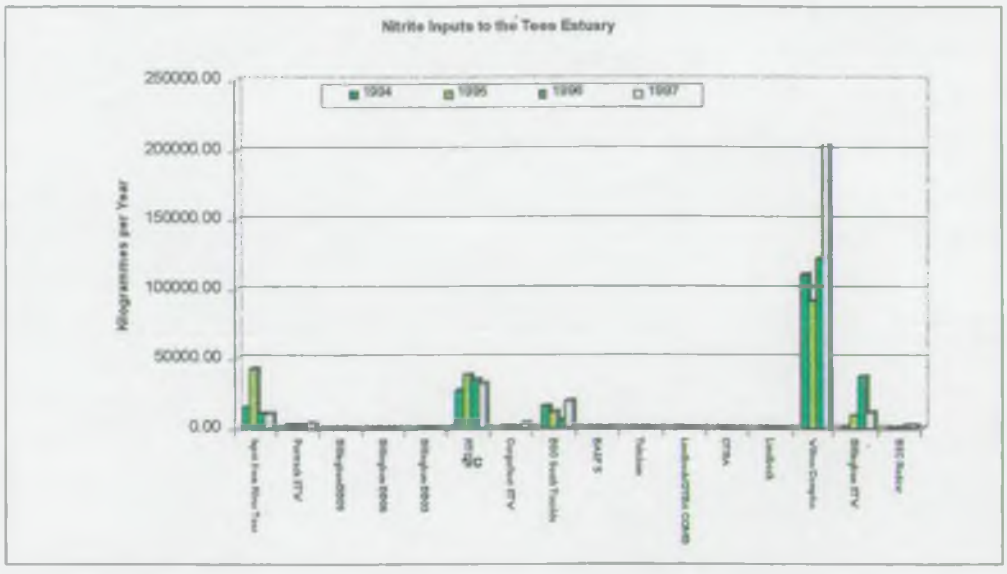
It is also possible that the increase in macro algal growth is a result of increased residence time of nutrients as a result of commissioning of the barrage. (i.e. reduced flushing times when river flows are low, and changes in circulation patterns) This change to the hydrographic regime could also mean that the Seal Sands area is now more prone to effects of nitrification as effluent high in Ammonia concentration is present for longer which in turn increases the opportunity for nitrification to occur so increasing nitrate\nitrite availability.

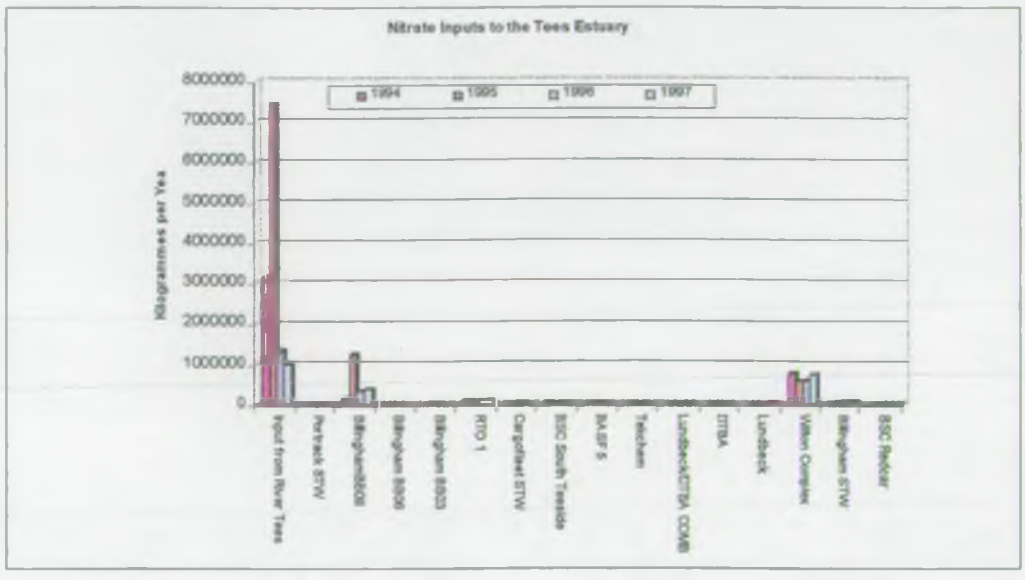
Concerns have also been voiced that a substantial decrease in available nutrients as a result of any changes enforced as a result of the area being designated SA(E) (or for any other reason) would impact the fauna on\in\over Seal Sands detrimentally as the primary food source would be depleted.

It is difficult to draw any conclusions from recent data as so many changes have been taking place; there may be no simple solution. More research is needed to investigate how such phenomena are linked and no targets for nutrients have been set, as yet, in the estuary.

Fig. 9 Nutrient inputs to the Tees Estuary as identified by PARCOM returns







The conclusions are as follows:

Table 25. Current State of Nutrient Levels in the Tees Estuary.

Stretch	Target	Current State
Barrage to Teesport	To be developed	Possible nutrient enrichment in surface layer year round visual and routine chemical monitoring
Teesport to Gares	To be developed	Nutrient enrichment resulting in formation of macro-algal (*enteromorpha*) mats. Mat coverage increasing in recent years. Possible sensitive area status, three-year winter nutrient level monitoring programme agreed.

Temperature

The ambient temperature of the estuary water is a major factor in determining which animals and plants can survive here. Sudden, or even gradual, changes in temperature can have a remarkable effect. If indigenous species are to maintain a presence on Teesside it is important that the temperature of the water is monitored. It is easy to overlook the importance of temperature, as it is not thought of as a 'pollutant', yet the effects of a marked temperature change can be devastating.

The main concerns in the Tees Estuary are about potential increases in temperature as a result of both local and global influences. Local concerns centre on the use of estuarine water as a cooling medium for industrial processes - in particular with regard to generation of electricity. Cooling water is by necessity heated in use and returned to the environment warmer than when abstracted. Discharge of cooling water to the estuary can have a considerable ecological impact as a thermal plume is formed in the receiving water and this can represent a disincentive to migratory fish. The extent of bacterial activity is strongly influenced by temperature - an increase in temperature of 8-10 degrees centigrade can cause a doubling of bacterial growth. This in turn increases the effects of mineralisation and nitrification and so can contribute to depleted oxygen levels. The Environment Agency has little control over global influences, such as rise in sea temperature due to global warming, but it can promote best policy to reduce the impact of local activity.

To measure temperature in the field, platinum resistance thermometers are used. These are generally very reliable and are incorporated into multi-parameter probes. Temperature readings are taken from surface, middle and bottom waters at each of the sites in the Lower Tees Survey, which includes EQS (Environmental Quality Standards) sites (see Figure 1) Surface temperature readings are taken at all sites at Greatham Creek. The Laing's Basin EQS site is also covered in this survey. Shore-based readings of the cooling water for Hartlepool Power Station are also taken. The Agency has two fixed monitoring stations on the Tees and each consists of two multi-parameter probes. The Agency operates a light aircraft, which carries a CASI (Compact Airborne

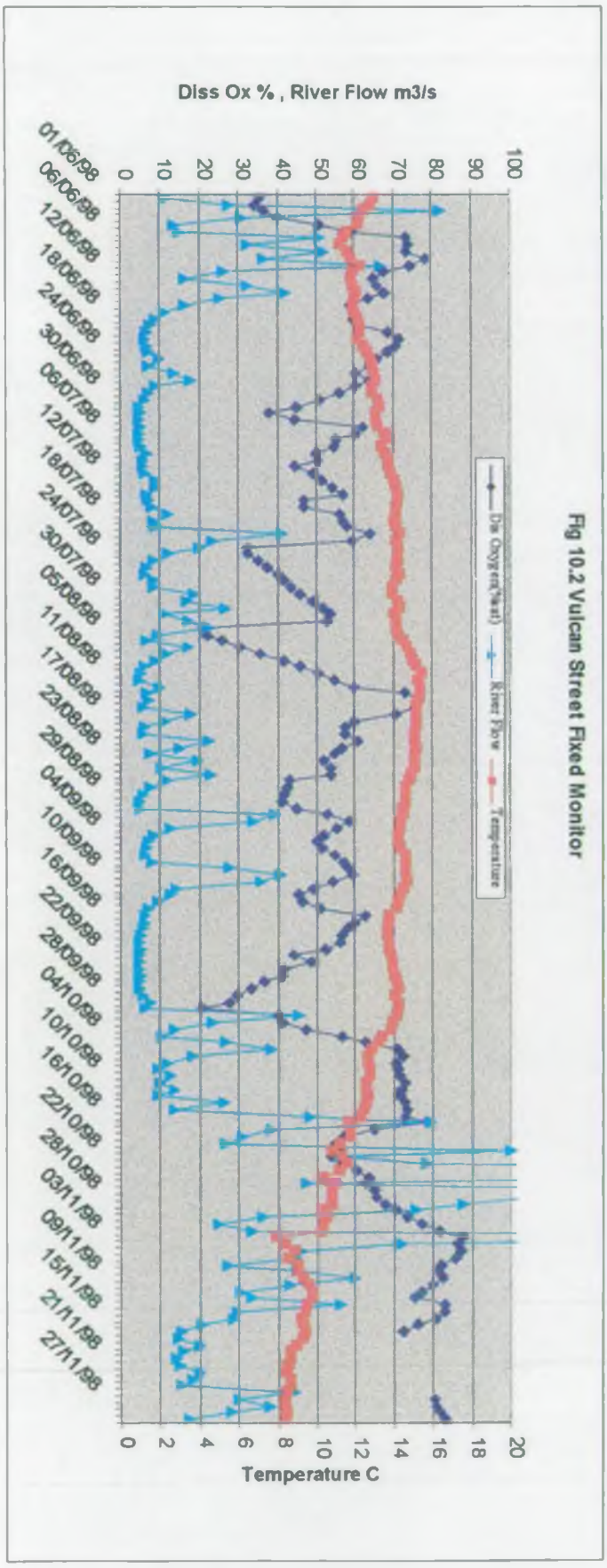


Fig 10.2 Vulcan Street Fixed Monitor

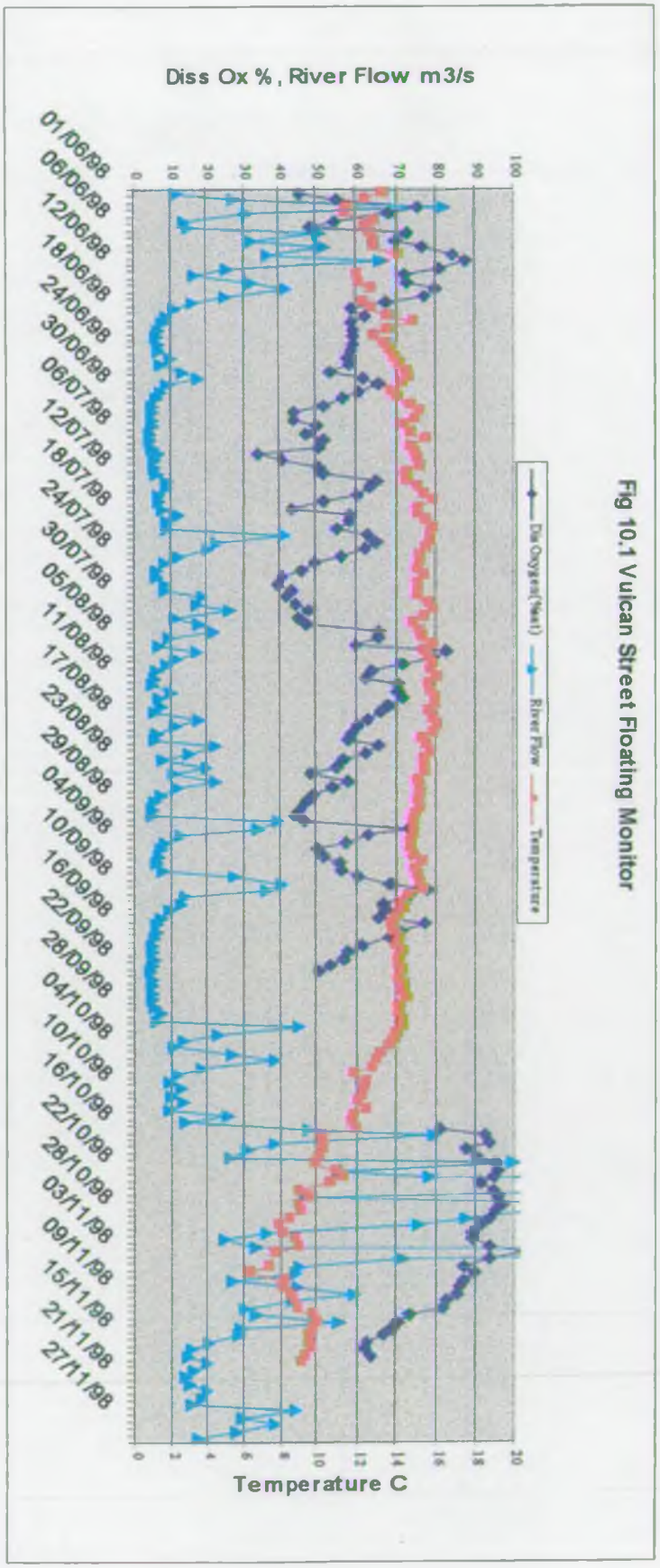


Fig 10.1 Vulcan Street Floating Monitor

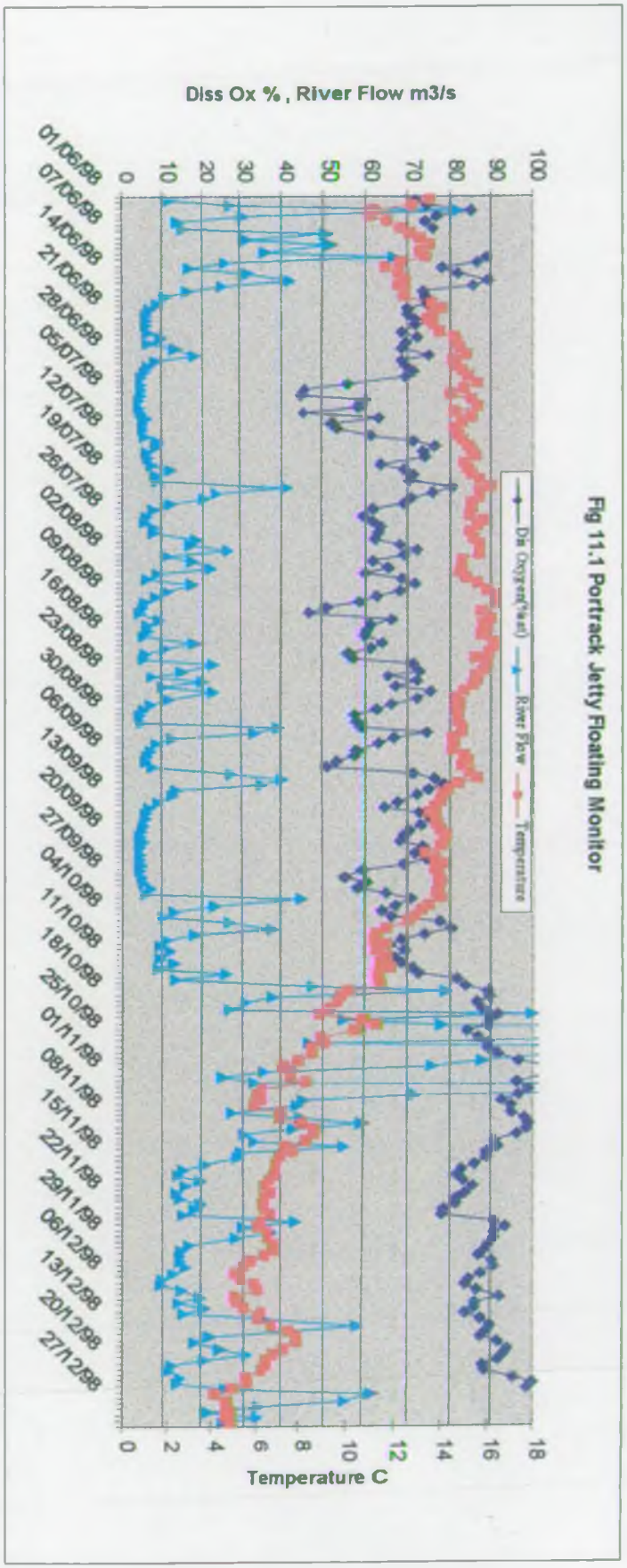


Fig 11.1 Portrack Jetty Floating Monitor

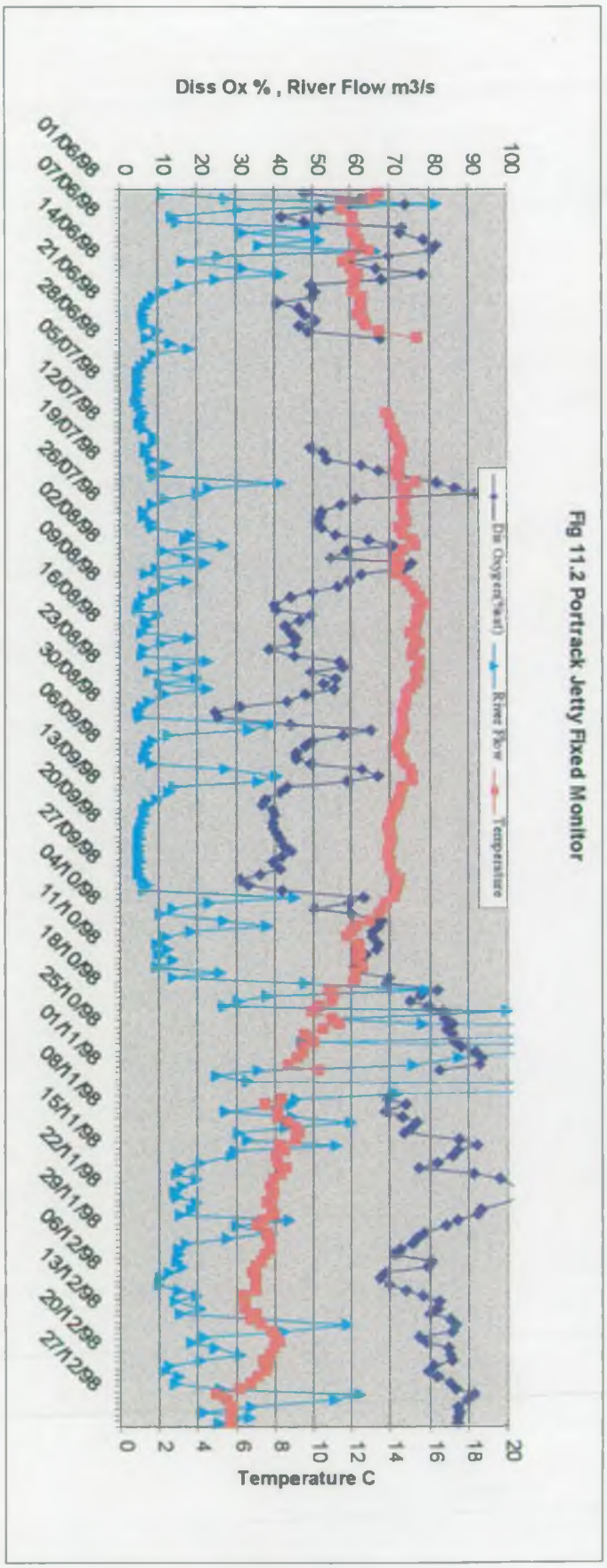


Fig 11.2 Portrack Jetty Fixed Monitor

Spectrographic Imagery) scanner and thermal imaging equipment. The aircraft is available for investigation of such phenomena as algal blooms.

Thermal imagery of the Tees can highlight discharges that are significantly warmer than the ambient temperature of the estuary. Thermal imagery has also shown that while at some states of the tide the warm plume of water from Hartlepool Nuclear Power Station is dispersed quickly, at others in may extend across the width of the estuary.

It should be noted that thermal imagery is of the surface water layer only. Daily mean plots of temperature as recorded by the continuous monitoring stations for the period of June to December 1998 are shown in figures 10 and 11.

It is recommended that monitoring of temperature should continue in order to establish if any long-term changes are taking place as well as to monitor discharges. Investigative work should be carried out to establish the effect of water temperature changes on biological and chemical oxygen-demanding processes within the estuary.

In order to maintain and encourage existing fauna and flora on the Tees the maximum temperature of the water should not exceed 25° C at any point in the water column.

The conclusions are as follows:

Table 26. Current State of Water Temperature in the Tees Estuary

Stretch	Target	Current State
Barrage to Teesport	< 25°C	1998 compliant at all times at all states of tide.
Teesport to The Gares	< 25°C	1998 compliant at all times at all states of tide.

Other Environmental Quality Standards (EQSs)

To ensure a healthy estuarine environment, high dissolved oxygen and low ammonia concentrations are essential. Since the early 1980s, the attachment of limiting conditions to consents to discharge has reduced BOD demand and ammonia loads to the estuary. Many other substances can be harmful to the development of a healthy and sustainable estuary environment and they fall within the broad categories of metals and organic substances. Because of the nature of the industrial process industry on Teesside the presence of these substances has always given cause for caution in relation to water quality and a number of screening programmes have been undertaken. The screening work established that the substances of main concern would get priority attention for consent or review purposes and confirmed, somewhat surprisingly given the diversity of processes on Teesside, that they were relatively few in number.

Examples of these are noted below.

- Metals - cadmium, mercury, copper, nickel, zinc, chromium, lead.
- Organics - Polychlorinated biphenyls, chloroform, 1.2 dichloroethane, benzene, toluene, xylene, nonyl phenol, tributyltin

The EU Dangerous Substances Directive and the Red List programmes were significant initiatives which provided the framework to address water quality issues involving metals and organic substances. The aim of the Dangerous Substances Directive is to seek the elimination of the discharge of the most dangerous substances in terms of their persistence, toxicity and bioaccumulation. A number of substances have had EQSs assigned by the EU that are concentrations to be met in receiving waters.

Other less dangerous List II substances are contained in Appendix II to the Directive and the setting of appropriate EQSs has been left to individual Member States. The objective here is to limit the discharge of these substances into the environment.

Control of List I and II substances in the water environment is achieved by the issue of consent conditions to the discharger by the Environment Agency under the Water Resources Act 1991. Agency monitoring programmes assess compliance with consent conditions and the quality of receiving water in relation to the EQSs and the directive substances and estuarine EQSs are shown in Appendix 2.

The Red List was announced by the Government in 1989 and consists of 23 substances and groups of compounds considered to present the greatest hazards to the aquatic environment by virtue of their persistence, toxicity or tendency to accumulate in food chains. Sampling in the estuary for dangerous substances takes place at six locations on a monthly to quarterly frequency. (See figure 1.) Sediment samples are also collected to ensure that concentrations are not increasing as time progresses. In the Red List programme, the discharges which contributed the majority of the substance load were identified from a programme of discharge sampling, analysis and flow monitoring. Individual discharges were then targeted for improvement.

Over the past 10 years in the Tees Estuary, problems of varying degrees have been encountered involving cadmium, mercury, copper, the process chemical 1,2 dichloroethane (1,2 DCE), chloroform and polychlorinated biphenyls (PCBs). These problems have been addressed by the combined efforts of the regulators and industry on Teesside and have been successfully resolved. Most concentrations in the estuary are well below EQS levels. The only EQS not met in the estuary is tributyl tin (TBT), a substance used as a mollusc anti-fouling paint coating on the hulls of large vessels. The gradual decline in TBT as it is phased out of use on vessels entering the estuary is possibly the best prospect of achieving the EQS in the longer term.

The conclusions, focusing on concentrations at Redcar Jetty, are as follows:

Table 27. List I & II Saline Environmental Quality Standards & Tees Estuary Monitoring Data

List	Substance	Annual Average EQS µg/l	Redcar Jetty Annual Average 1997 µg/l
I (Statutory)	Mercury*	0.3D	0.02
	Cadmium*	2.5D	0.02
	Hexachlorocyclohexane*	0.02	0.003
	Carbon Tetrachloride	12	0.12
	p,p DDT*	0.01	0.001
	Total DDT*	0.025	0.012
	Pentachlorophenol*	2	0.1
	Total Adrins≅*	0.03	0.009
	Aldrin*	0.01	0.002
	Dieldrin*	0.01	0.003
	Endrin*	0.005	0.001
	Isodrin*	0.005	0.004
	Hexachlorobenzene*	0.03	0.001
	Hexachlorobutadiene*	0.1	0.003
	Chloroform	12	0.82
	1,2 Dichloroethane	10	0.36
	Trichloroethylene	10	0.11
	Perchloroethylene	10	0.1
	Trichlorobenzene	0.4	0.03
Old List II (Agency Mandatory)	Lead	25D	4.5
	Chromium	15D	3.0
	Zinc	40D	13.7
	Copper	5D	1.8
	Nickel	30D	2.7
	Arsenic	25D	
	Boron	7000	3656
	Iron	1000D	38.8
	pH	6-8.5	-
	Vanadium	100	20.
	PCSD=s	0.05P	-
	Cyfluthrin	0.001P	-
	Sulcofron	25P	-
	Flucofron	1P	-
	Permethrin	0.01P	-
	Tributyltin Triphenyltin	0.002 0.008	0.007-

On a final note, in March, 1998, the Government introduced new regulation to control a number of new List II substances, many of which are pesticides or chemicals used in the manufacturing industry, for example benzene toluene and xylene. Some of these substances, shown in Appendix 2, may be relevant to the Tees Estuary, where they have been targeted within consent conditions for some time.

There is concern that some industrial chemicals can act as endocrine disrupters and interfere with the hormone systems in organisms including fish and molluscs. The initiative taken by the Environment Agency on endocrine disrupting substances has highlighted a number of chemicals that may be related to the issue and some are produced on Teesside, including nonyl phenol. Although a developing issue, discussions with industry about nonyl phenol have already taken place to investigate and develop ways of reducing discharges to the estuary.

By far the greatest causes for concern, however, are the effects of oxygen depletion in the estuary. As improvements are made, then more subtle effects arising from substances of concern, such as those implicated in endocrine disruption, may become more apparent than at present.

Part 2: *A strategy for the Tees Estuary*

Part 2 – *introduction*

Part 2 of this document sets out a sets out to create a shared vision for the Tees Estuary, to inspire all stakeholders and to provide a framework for the continued improvement of water quality. It also sets out to highlight issues in order to stimulate discussion. By setting objectives, targets and standards and by providing environmental indicators to assess the state or 'health' of the estuary environment, industry, conservation groups and others are provided with a long-term planning framework. This will enable us all to focus our environmental obligations on common goals and to co-ordinate our actions and allow us to prioritise our commitments. In agreeing and setting targets, regard will be given to social and economic aspects.

The strategy itself is non-statutory, but in delivering its objectives it considers the existing legislative framework and statutory requirements placed on estuary users and the Agency itself, together with the European and UK Government initiatives that will lead to the improvement of some of the existing statutes.

This strategy looks to the future and is expected to stand into the next millennium. The emphasis is where we are now and where we would like to go. Where we have come from is well documented elsewhere. It builds on the water quality targets set for the estuary in the early 1980s, which will be substantially met through continued improvement to operational practices by 2002. The strategy sets out new targets and indicators that will provide a new challenge for the future of both the regulator and the regulated.

The Agency acknowledges the major efforts made by industry and others over the last 30 years to get us to the position where we can consider what happens next, now that a migration fishery is being established.

The main objectives of the strategy are to:

- Identify new targets for the Tees Estuary for industry and conservation groups to aspire to
- Identify new environmental indicators for the management of the water environment into the next millennium
- Provide a framework within which state of the environment reporting can be periodically undertaken
- Consider the cost/benefits of the issues
- Consider the impact of new initiatives, legislation and further development on the future of the estuary and its users
- Ensure that the Agency fulfils its statutory duties
- Provide background for informed discussion and appropriate action.

The Vision

The Agency's vision of the Tees Estuary is one of sustainable development producing a healthy and prosperous environment for all. This implies a balance between the concepts of no detriment to socio-economic advancement and at the same time no detriment to the environment as measured through environmental performance indicators (and ideally continuous improvement to the environment). This balance must be achieved through the application of sound science while paying close attention to the costs and benefits of available options.

Total intolerance of pollution is not an option in the industrialised society in which we live today. The community of Teesside has both direct and indirect influences on the estuary. Purchasing decisions support industries located on the banks of the river, which in turn employ people living in Teesside.

The Agency cannot achieve this vision in isolation and will seek to involve all relevant parties, be they from industry, local authorities, educational establishments, conservation groups or the

Industry on Teesside

Newport Bridge

Sunset over Teesside

Teesside at night

Links with other plans

This is a summary of the existing planning framework in which this document sits.

Regional Planning Guidance for the Northern Region – This provides direction from the Department of Environment, Transport and the Regions and is currently being reviewed. It sets the strategic framework for growth and regeneration and lays down broad principles.

Local Authority Development Plans – These exist for the four unitary authorities of Hartlepool, Middlesbrough, Redcar and Cleveland and Stockton-on-Tees. The new Tees Valley Structure Plan will provide the strategic context for the above local plans and Darlington. This document has considered the land use and conservation policies provided in local planning documents.

Local Environment Agency Plan (LEAP) – In 1994, the National Rivers Authority produced a Catchment Management Plan covering the River Tees from source to mouth. This set out proposals for actions by the NRA over the following five years, to optimise the environmental potential of the catchment.

With the formation of the Environment Agency in 1996, this plan was broadened and reviewed to cover wider environmental issues and following consultation, the Tees Local Environment Agency Plan was issued in September 1997.

Environmental Legislation

A summary of the main requirements of European Union Directives and UK legislation relating to the water environment is given at Appendix 3.

USES AND USERS OF THE ESTUARY

The Tees Estuary is used for a wide range of activities, including effluent disposal, recreation, navigation, fishing, conservation, water abstraction and the siting of industry and commerce.

Likewise, it is used by different sectors of the community including educational establishments and scholars, special interest groups such as industrial archaeologists, wildlife and conservation enthusiasts, anglers, tourists and water sport participants.

Sewage and industrial effluents disposal

Five impacts arise from the discharge of sewage and industrial effluents into estuarine waters. These are associated with de-oxygenation, toxicity, aesthetics, eutrophication and pathogens. Sewage and industrial effluents are likely to cause local depletion of oxygen upon discharge into controlled waters. Toxic materials such as ammonia, some organic substances and heavy metals, discharged into the water environment may cause immediate death to organisms or bio-accumulate to hazardous levels. The presence of faecal matter and sewage-derived litter on the shores, the visible impact of coloured or warm (steaming) effluents and the emission of unpleasant odours can cause aesthetic displeasure. Nutrients present in sewage and industrial effluent may cause eutrophication, which is the enrichment of waters with nitrates and phosphates. Epidemiological studies have been carried out on the effects of sewage discharges and while the results of many have been inconclusive, there is still public concern that sewage-tainted water may pose a health hazard. This is of less significance in an estuarine environment where bathing is not encouraged for a variety of reasons, the most significant being safety.

Sewage disposal

Sewage is a term covering a mixture of environmental waste products including faecal products, washing water, industrial, commercial and transportation solutes and storm run-off. In urban areas, including Teesside, sewer conduits were built to convey sewage effluents to the nearest water body, in this case, the estuary.

The main discharges of treated sewage into the Tees Estuary takes place via Greatham Creek for effluent from Billingham Sewage Treatment Works, and via Dabholme Gut for effluent transferred from Portrack Primary Treatment Works, Cargo Fleet preliminary treatment works and from Eston for treatment at the new Tees Estuary Environmental Scheme (TEES) at Bran Sands, operated by Northumbrian Water Ltd. (NWL)

There are various references to the TEES scheme in this report and the following describes why this initiative is so important.

The scheme is a response NWL to increasingly tight environmental standards. Under the EU Urban Waste Water Treatment Directive, NWL is obliged to provide secondary treatment for the effluent discharged from its sewage treatment works. In addition, major industrial companies on Teesside are also being required to reduce the pollution load entering the Tees.

TEES will see the phased construction of a large effluent treatment plant and the laying of transfer sewers from Portrack, Cargo Fleet and Eston which will end the discharge of partially treated sewage and significantly reduce the industrial effluent discharge load into the river. ICI, Dupont and British Steel have already contracted NWL to undertake their industrial effluent treatment at the plant, which will be fully operational in 2001 and will treat around 215,000m^3 of effluents per day and remove pollutants equating to over 52 tonnes per day of BOD. An additional facility to be provided at Bran Sands is a regional sludge treatment centre catering for the whole NWL area. The new plant will dry the sludge to produce biopellets which can either in future be gasified to produce electricity, following the construction of the appropriate plant, or else used as a fertiliser in agriculture.

To control the various effluent streams treated at the facility, three discharge consents have been issued by the Agency to NWL.

Portrack Sewage Treatment Works is situated on the north bank of the river near Newport Bridge. In July 1997, effluent from the works was transferred to the Bran Sands effluent treatment centre as part of the TEES scheme. Primary flows are being discharged into Dabholm

Gut after treatment for septicity and disinfection. Secondary treatment at Bran Sands will be commissioned by the end of 2000. Portrack is being retained as a storm water storage site.

Effluent from Cargo Fleet Sewage Treatment Works was transferred to Bran Sands in Spring 1999 for primary treatment with disinfection. Secondary treatment will be applied from 2000. Removing the continuous discharge of Biochemical Oxygen Demand (BOD) and ammonia at this point on the estuary will have a significant effect on the water quality.

There have been a number of small, yet , collectively significant , discharges of untreated sewage effluent entering the Tees at various locations.

During July 1997 Snowdon Road pumping station and Acklam Street pumping station were connected to the Cargo Fleet system. Vulcan Street pumping station followed in September 1997. The Normanby Road discharge was connected to the South Bank Intercepter, in turn connected to Cargo Fleet in December 1998. These facilities will now only discharge untreated sewage to the estuary under storm conditions.

A discharge of fully treated sewage is made from Billingham Sewage Treatment Works in Cowbridge Beck, a tributary of Greatham Creek, which flows into the lower reach of the Tees Estuary.

Industrial effluents

The following, together with individual consent details (which are available in a supplement to this report), describes the major industrial discharges to the Tees Estuary. There are a number of facilities/companies without specific consent or release details and this is because they discharge to the Tees via the RTO1 outfall or the Wilton outfall, (also known as Dabholm Gut). Both outfalls have specific consents in force, which are described, together with their respective releases during 1997, separately.

The discharge of industrial effluents from the Wilton Chemical Complex is one of the largest single consented discharges in the country. It is also one of the most complex.

Outfalls

Dabholm Gut viewed from penstocks at Wilton

RT01 Bamletts Bight at Billingham

Cargo fleet now diverted to Bran Sands

The Billingham site is the largest accumulation of chemical processes on the north bank of the river. Previously wholly occupied by ICI, divestment has meant that other major companies including Zeneca, Terra and Air Products – now have a significant presence here. The individual businesses are served by outfalls discharging either directly into the Tees or Billingham Beck.

There are a number of direct company discharges into the Tees and details of these are available in a supplement to this report.

A summary of the releases made to the Tees Estuary during 1997, in terms of BOD and Ammonia, is given in Appendix 4.

Recreation

Household expenditure on recreation has increased substantially over the past 30 years and part of this increase relates to time spent at the coast and around estuaries. Recreational activities, whilst important to the local economy, can create pressures on the environment and be detrimental if not properly controlled. In addition, conflicts can exist between the different activities.

The heavily industrialised nature of the Tees Estuary, lack of landward access, the busy commercial port and the history of poor water quality have in the past placed constraints on the use of the estuary for recreational use, particularly for water sports. Interest groups such as commercial fisheries, anglers, water sport participants and nature conservation organisations have all been keen to see water quality improvement to the Tees Estuary. Yet for many years the estuary has supported a wide range of land and water based recreational activities. These include bird watching, wild fowling, recreational field studies, angling, sailing and sub-aqua. In addition, the immense industrial and maritime heritage of Teesside and its wealth of nationally important habitats for wildlife provide the potential to attract visitors to the area.

The Tees Barrage, presently the responsibility of the Commission for New Towns (CNT) has resulted in the impoundment of upstream water at a permanent high tide level. It prevents the

mixing of fresh and tidal waters and has created a 22km long fresh water lake. The Barrage has had a significant impact on the visual attractiveness of the river and also on its water quality and biological resources. One of its main purposes was to encourage economic regeneration of Teesside. Other functions include protecting the ability of migratory fish to move upstream and to increasing access to the river for recreational use, particularly for water sports and angling.

Barrage development needs to be carefully managed to minimise environmental impact and the consequential pressures. Concerns existed prior to the construction of the Tees Barrage that an eco-system may develop downstream that is severely restricted by the unnatural salinity regime and with a habitat dominated by a few opportunistic species.

In addition, the stratification of impounded waters with respect to salinity and which are poorly oxygenated along the bed may also be problematic. The Barrage can also provide a threat to migrating fish and a fish pass was considered necessary to allow their free passage. Other routes of passage exist and are in more frequent use by navigating species. Extensive post barrage monitoring has shown that the Barrage has had a significant positive impact on upstream water quality and that its impacts on the lower estuary are largely as predicted and are manageable.

Recommendation

The Agency will work with the Commission for New Towns to review the Tees Barrage Operating Rules

Ports and Navigation

The main port on the River Tees is Teesport. It is one of the five largest ports in the UK and the third busiest. The port facilities are managed by the Tees and Hartlepool Port Authority (THPA), which was privatised in 1992 and is now a limited company (THPAL). It aims to promote commercial maritime activity and develop facilities by operating a safe harbour with sufficient deep water provision. The Authority's jurisdiction runs from near the barrage to three miles offshore and between Blackhall Rocks, north west of Hartlepool, to Saltscar Rocks, Redcar. It has powers to regulate navigation, prevent pollution, regulate mooring and berthing and to introduce bye-laws.

Dredging

Dredging at the sea-bed takes place to create and maintain channels for navigation and to extract minerals - mainly sand and gravel - from the marine environment. Dredged material from the Tees Channel continues to be disposed of at a site three miles offshore and this has been the case for some hundred years. The sea disposal point is vital in maintaining the marine sediment budget.

Potential environmental damage can ensue from dredging which is not properly managed. Studies have shown that present concentrations of heavy metals in the dredged, navigable channel are close to natural background concentrations. However, less disturbed locations are likely to have much greater concentrations of contaminants as a direct consequence of the industrial history of Teesside. Hence great care must be exercised if dredging is planned in such areas to prevent redistribution of pollutants or re-suspension of sediment in the water column.

Current and Future Practice – Tees Hartlepool Port Authority Ltd (THPAL)

Currently, as part of its many activities, THPAL monitors the river for the presence of heavy metals and PCBs (poly-chlorinated biphenyls). The results of this monitoring are provided to the Agency. Sand movements, together with patterns and rates of siltation are also monitored and results again forwarded to the Agency. It has been established that Seal Sands is experiencing an increase in sediment coarseness which has been attributed to marine influence. However, research by THPAL suggests that wind-bourne sediment movement to Seal Sands from North Gare Sands may be responsible.

THPAL is investigating the use of position fixing techniques and dredging practice. This should minimise the amount of dredging activity and that which remains will be better targeted. This approach will bring both economic and environmental benefits.

Adequate port facility provision is required for general rubbish, noxious liquids and waste oil. THPAL has been proactive in the preparation of a port waste management plan and has

contributed to drafting and implementing waste management plans throughout the UK since 1996. The Tees plan is held in high regard, demonstrating important examples of best practice.

Recommendation

The Agency will work with the Tees & Hartlepool Port Authority Ltd to:-

- **seek to optimise dredging operations for mutual benefit**
- **assist in their production of a Port Waste Management Plan**
- **assist in the production of a contingency plan to deal with oil spills in the estuary**

Fisheries

The Tees Estuary is an important habitat for juvenile flatfish and the highly productive expanses of mud substrate, both intertidal and subtidal, within the estuary, provide an abundant food source of bottom dwelling invertebrates. Flounder are present in low numbers throughout the estuary, moving out into the coastal areas only to spawn. Plaice are present in the higher salinity waters of the lower reaches, as are roundfish such as Sprat and Herring. Whiting are the dominant species in catches along the estuary. Between Portrack and Teesport, fish life is depleted – a likely result of the industrial effluent and sewage loads. The estuary below Teesport supports a wide variety of fish life. A greater number of different species are evident in this stretch of the estuary.

In recent years, improvements in water quality have lead to the return of migratory salmonids in increasing numbers. Anglers and the Environment Agency have recorded instances of salmon upstream of the barrage. The Agency has also noted an increase in species diversity in trawls between Middlesbrough and Portrack.

Generally, commercial fishing around the Tees Estuary is limited to eel fishing and there is currently one licence holder entitled to fish. Furthermore, 20 predominantly part time gill and trammel net equipped boats are based at South Gare. They work in the general vicinity of the estuary, fishing for codling, plaice, sole and turbot. As far as commercial salmon fishing is concerned, the Tees, together with the other migratory rivers in the region, has an area around the

mouth where salmon netting is prohibited. Salmon netsmen fish from most of the main ports in the area, with five licences being held by craft at Hartlepool and two at Redcar.

The Agency has outlined its policies with respect to fisheries in two publications – a national 'Action Plan for Fisheries', and a more local 'Regional Coarse Fisheries Strategy'.

Recommendation

The Environment Agency will produce a 'Salmon Action Plan' for the River Tees. The main purpose of this plan will be to review the existing stock and fishery status, to develop targets to assess stock and fishery performance in the future, and to draw up a list of costed actions to address the main issues limiting performance.

Conservation

The Tees Estuary is recognised, both nationally and internationally, for its biological resources – indeed, commercial exploration of shellfish, fish and wildfowl occurred during the 19th and early 20th century. Industrial development of the estuary has had a dramatic impact upon the ecology of this dynamic estuarine environment in the past, yet there has been steady improvement since the early 1970s. Water quality has been enhanced and the importance of nature conservation has increased significantly. Today, most of the remaining inter-tidal area of Seal Sands is classified as a National Nature Reserve, as well as being a Special Protection Area (SPA) (under the EU 'Birds' Directive) and a RAMSAR site (Protection of Wetlands of International Importance especially for waterfowl. Elsewhere in the estuary there are areas designated as Sites of Special Scientific Interest (SSSI), Sites of Nature Conservation Importance (SNCI), Cleveland Wildlife Trust Nature Reserves (CWT Reserve), and Country Park. There is also a proposal for an International Nature Reserve west of the A178 (Saltholme Pools and west of Haverton Hole).

Recommendations

As required by the Habitats Directive, the Agency, in conjunction with English Nature, will:-

- **review existing authorisations permitting discharges to the estuary to assess whether they are having a significant adverse effect on the Tees Estuary SPA**

- **amend or revoke authorisations if there is an adverse impact, unless there are overriding reasons of public interest.**

Water Resources and Abstraction

Water is abstracted from the River Tees at six locations downstream of the Tees Barrage to service the needs of industries around the estuary. Each of these abstractions is licensed by the Agency and monitored periodically.

Table 28. Licensed Abstractions of Water from the Tees Estuary.

Ref No.	Abstraction Licence	Lic Day (TC MA)	Lic yr (m3/d)	Use	Grid Ref
7015	Northumbrian Environmental Management Ltd-Teesside Energy from Waste (efw) Plant	96,000	3,501	Cooling	NZ481219
9957	British Steel Plc-Blast Furnace	210	77	Cooling	NZ533225
9972	British Steel Plc-Power Station	72,272	263.8	Cooling	NZ547259
9967	Nuclear Electric-Hartlepool Power Station	3,101.9	109,898.8	Cooling	NZ529268
9987	Kvaerner Oil & Gas Ltd	2,000	50	Cooling	NZ497215
9969	Tees Bulk Handling	772.7	77.3	General Industry	NZ546235

ENVIRONMENTAL PRESSURES

The following section discusses the major pressures on the Tees Estuary environment and provides a regulatory framework for managing those pressures, where relevant to the duties, aims and objectives of the Agency. Whilst an appreciation and understanding of these factors is extremely important, the success or otherwise of the Agency's actions will be judged mainly on how it is able to reduce or alleviate the pressures themselves. For example, pressures include the quantities of substances abstracted or discharged into the environment. The major pressures on the Tees Estuary environment are land use - especially future industrial development; effluent treatment and disposal, and climate change and sea level rise. Other existing pressures are shipping and recreation.

Land Use

The lower reaches of the River Tees, its floodplain and estuary have historically witnessed dramatic changes in morphology, habitat and associated wildlife, as a direct result of land use changes. Today, Teesside is renowned for its chemical and petrochemical industries and has become the largest integrated chemical facility in Europe. This was spawned by the establishment of a Government sponsored pilot plant to make ammonium nitrate for explosives in 1916. By 1960, 500 acres were occupied by chemical production facilities. In 1963, further expansion had taken place on the north bank with the construction of the North Tees petrochemical works.

In response to a decline in traditional industries, like shipbuilding additional petrochemical activity was later encouraged along the banks of the lower estuary to boost employment. This led to further land reclamation at Seal Sands, which was completed in 1974. As a result of these man made changes to the estuary, sediment deposition patterns have been affected and are still undergoing adjustment. Of the original 2470 hectares of inter-tidal mudflats and sandbanks present in 1850, only 200 hectares now remain.

The potential for conflicts of interest between development and nature conservation within the estuary still exists. However, the Government recognises the need for planning controls where dual land-use designations exist.

Two levels of dual designation exist in the Tees Estuary – sites of nature conservation importance/industrial development and sites of special scientific interest (SSSIs)/industrial development. The former has been selected by the Cleveland Wildlife Trust but do not enjoy the benefit of statutory protection. The latter designations are afforded more robust protection. SSSIs are designated for special interest by reason of their flora, fauna, geological or physiographical features by English Nature.

Local Authority Development Plans make specific allocations of land for different uses and set out detailed policies for the control of development. Many of these policies have the potential to influence the estuary. In addition to Local Authority land use planning policies, THPAL has jurisdiction over river frontage and other development on the Tees.

Whilst statutory protection now applies to almost all of the inter-tidal habitats remaining, development pressures do still exist and could threaten areas of land with conservation value, especially those with less robust protection. Careful planning and collaboration has the potential to minimise habitat destruction by future development and should be encouraged.

Development in Coastal Floodplains

Coastal floodplains are areas of low-lying land along our coast that can be flooded by the sea. Throughout England and Wales, including on Teesside, a considerable amount of development has already taken place on the coastal floodplain as well as on river floodplains. Consequently, people and property in these areas are at risk from flooding. This leads to pressure for new or improved coastal and river flood defences, with consequent long-term maintenance implications.

There is an ongoing programme of both Environment Agency and local authority flood defence works. These works are in many instances necessary to provide or to ensure the continuing existence of physical defences to protect development that has taken place in floodplain areas.

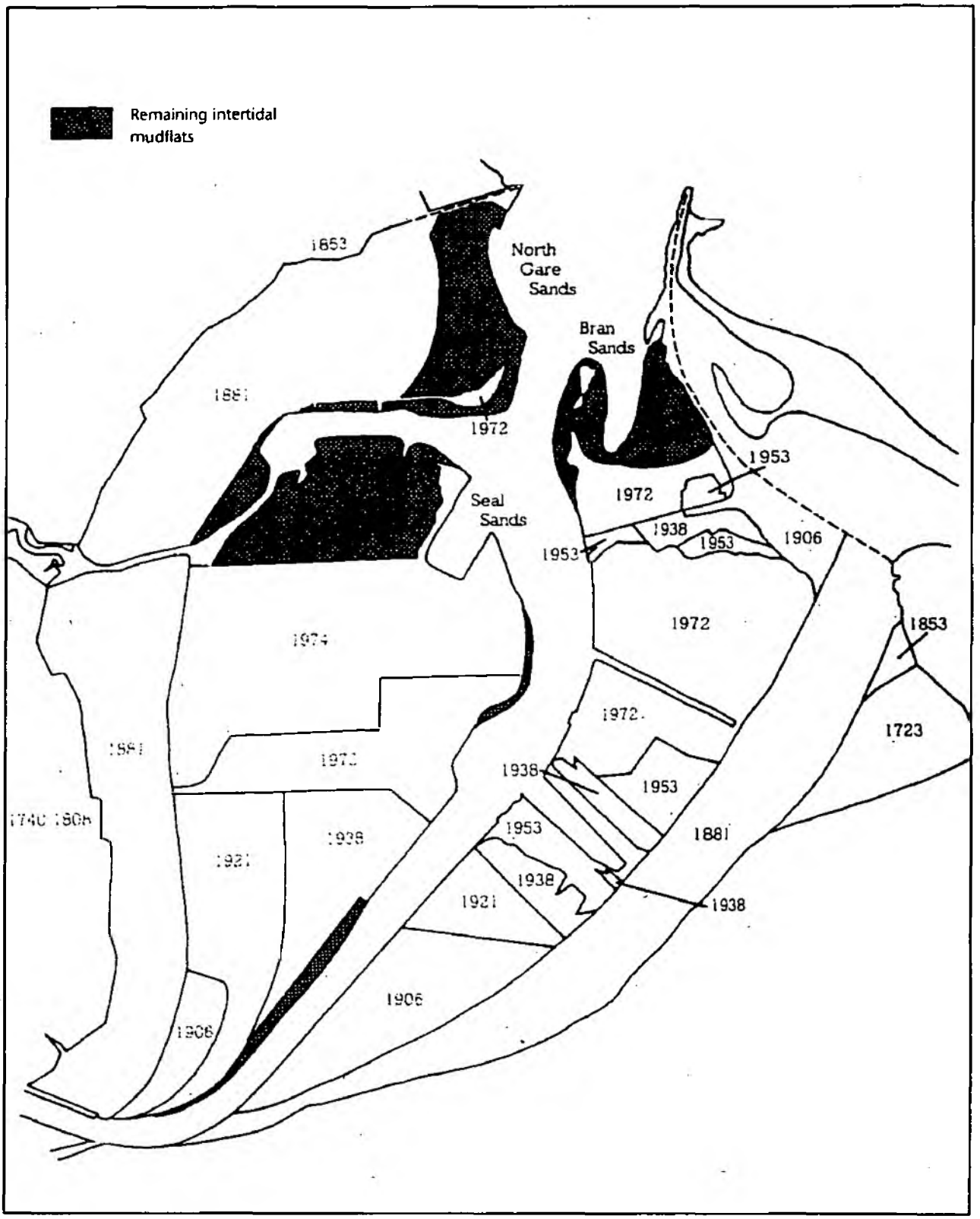
Industries

Targor polypropylene plant, Wilton

Tanker berths, North Tees

Industry at Billingham by night

Remaining intertidal mudflats in Tees Estuary



The dates of the progressive piecemeal land-claim episodes in the Tees Estuary.
Dates within each block are those by when the land-claim is known to have been completed.

Contaminated Land

Certain areas of land surrounding the Tees Estuary have been contaminated by past industrial use. These contaminants can escape to surrounding land and watercourses causing pollution. The Local Borough Councils recognise this problem. The redevelopment of contaminated sites is supported by the Agency, provided it is carried out to a suitable standard, which results in improvements to the environment.

Recommendations

The Agency will:

- **influence future land use planning policy to ensure development around the estuary is sustainable.**
- **encourage the remediation of contaminated land**

Effluent Treatment and Disposal

Industrial and domestic effluents discharged to the Tees Estuary contain a wide variety of compounds. These include both dissolved and suspended organic matter, detergents, oils, dissolved salts, raw materials, reaction products and catalysts used in chemical processes, solvents, paints, cleaning and anti-fouling agents, as well as substances released through accidental or incidental spillage.

Many of these have low biological significance at the concentrations emitted, while others have the potential to be highly ecotoxic. Some may be rapidly eliminated from the aquatic ecosystem by various routes; others may be persistent or even concentrated within a section of the ecosystem. Water soluble pollutants may be removed rapidly from the estuary into Tees Bay, whilst organic pollutants such as some hydrocarbons and heavy metals may be absorbed onto suspended silt or organic particles and be deposited in the estuarine sediment or in the tissue of living organisms.

Oxygen

One of the main indicators of the health of the Tees Estuary is the amount of oxygen dissolved in its waters. It is dissolved from the air or is a consequence of the photosynthesis of plants. Fresh water can hold more dissolved oxygen than seawater, and cold water more oxygen than warm water.

Oxygen can be consumed from the estuary in several ways leading to oxygen depletion. Estuarine animals and plants consume oxygen for biological processes, for example respiration. Estuarine bacteria consume oxygen to oxidise ammonia present in sewage and industrial effluent, to produce nitrite and subsequently nitrate. The decomposition of organic matter also consumes oxygen.

The consumption of oxygen from the water by chemical reactions can be measured and expressed as the biochemical oxygen demand (BOD).

For the first time in over 50 years, the Tees Estuary had dissolved oxygen present along its full length and depth for the whole of 1997.

Table 29. BOD Loads to the Tees Estuary.

Average Daily Load of BOD Discharged to the Tees Estuary (Tonnes/Day)	
1970	504
1980	109
1990	150
1996	100
1997	95
1999 (projected)	60
2002 (projected)	40

Eutrophication

Eutrophication refers to the enrichment of waters by inorganic nutrients, which results in the stimulation of an array of symptomatic changes. These include the increased production of algae and/or other aquatic plants, affecting the quality of the water and disturbing the balance of organisms within it. Such changes may be undesirable and interfere with water uses. At Seal Sands in recent years, there have been many reports documenting the increased occurrence of algae associated with eutrophication, mostly relating to the green algae *Enteromorpha*.

The Tees Estuary is being investigated for nomination as a candidate 'Sensitive Area' under the Urban Waste Water Treatment Directive, because of the effects of algal growth. This results in a smothering effect depriving the benthic macro fauna of oxygen. This may then have a knock on effect higher up the food chain on fish and wading birds. To satisfy its legal obligations, the Agency is required to undertake studies to determine the impact of nutrients on estuarine habitats and in future this work will focus particularly on Seal Sands. Extensive monitoring will take place between this year and 2001 to identify nutrient sources and their impact prior to determining whether nutrient load reductions will be required.

Sediment Oxygen Demand

The demand for oxygen is often greatest near the estuary bed where the sediment is home to various organisms requiring it for respiration. Oxygen-demanding substances may adhere to sediment particles further reducing that available for organisms, and increases in turbidity can release contaminated sediment into the water column exacerbating this further.

Recent work in the upper estuary has shown that sediment oxygen demand is significant where measured although it is still not possible to determine its significance across the whole estuary and through time.

Cyanide

In 1930 cyanide emissions from the coke ovens associated with steel making were linked to the decline of the salmon population in the Tees. In 1970, 2 tonnes per day were discharged, double the 1930 level and concentrations approached those lethal to some aquatic species. Over the next 25 years, emissions have been reduced by 75% overall and by 90% in the upper estuary.

Heavy Metals

Compounds containing heavy metals such as Cadmium, Mercury, Lead, Zinc, Chromium, Copper, Vanadium and Arsenic have been discharged to the Tees over the last 100 years, or leached from past deposits of solid waste on land adjacent to the river. Since heavy metals have a low solubility in water, they tend to be absorbed on to clay and organic particles and are deposited with fine sediment. Dredging and excavation of land contaminated by earlier industries can release a flush of pollutants. The only effective eradication may be their physical removal.

Bioaccummulation

Many substances, such as polychlorinated biphenyls (PCBs) and pesticides are persistent in the environment and accumulate in biological tissues where they may exert toxic effects. Because of this some substances have now been banned. Some heavy metals are also chronic poisons to most plants and animals, and can accumulate in organisms higher up the food chain. The Dangerous Substances Directive seeks to eliminate the discharge of the most dangerous substances in terms of their persistence, toxicity and tendency to bioaccummulate. In the UK control is exercised through conditions attached to consents to discharge under the Water Resources Act 1991 and Integrated Pollution Control Authorisations issued under the Environmental Protection Act 1990. Agency monitoring programmes assess compliance and the quality of receiving water in relation to Environmental Quality Standards (EQSs).

Ecotoxicological Studies

Bioassays are ways of measuring environmental quality by observing the response in indicator organisms exposed to environmental samples. They are highly specific, since not all organisms

are equally sensitive to all toxic substances and can yield important information about water quality. Studies in the Tees estuary between 1991 and 1995 as part of the National Monitoring Programme indicated that there was cause for concern about water and sediment quality. No single contaminant appears to be responsible and so the effects are likely to be due to several contaminants acting together. In addition, sources of these contaminants are also unknown but probably consist of both contemporary sewage and industrial discharges, and historical contamination.

Tees Estuary Mathematical Modelling

The Agency uses two mathematical models of the River Tees to assist management decisions for the protection of the aquatic environment. One model is two-dimensional and includes the entire estuary. The other is three-dimensional and allows the 'footprint' of specific discharges to be examined. Both models are used to predict how water quality would be affected by variations in effluent inputs to the estuary and allow different tidal and river flow conditions to be considered. Complex processes such as nitrification and sediment oxygen demand can be considered.

The overall objective of this work is to be in a position to predict, as far as reasonably practicable, the consequences (for surface water quality) of pollution abatement actions which are being, or might need to be, considered and to assist the Agency determine appropriate discharge leads to achieve the required water quality standards.

Recommendations

The Agency will:

- **determine the sources of and impact of nutrients on the lower estuary intertidal areas with a view to identifying whether future nutrient load reductions are required.**
- **encourage waste minimisation initiatives to remove pollutants at source.**
- **refine the Tees Estuary mathematical models in order to better understand estuarine processes, especially the impact on dissolved oxygen concentrations of sediments, the nitrification of ammonia, and the operating regime for releasing water from the barrage to enable the use of the models as a management tool for the estuary.**

- **Agree Environmental Quality Standards (both statutory and non-statutory) which are, where possible, limited to species resident in the estuary.**

Synthetic Organic Chemicals and Endocrine Disruption

Substances that disrupt the normal functioning of hormones, such as oestrogen mimics, have emerged as a major environmental concern in recent years. The number and range of 'endocrine disrupting' substances may be large and continues to expand with further studies.

Evidence of changes in the reproductive systems of wildlife are well documented and one of the most notable examples was the identification of a condition known as 'imposex' in dog whelks around the UK coast. By the late 1980's it was clear that this condition, where females acquire male characteristics that prevent the females from laying eggs, was due to the use of tributyltin as an antifouling agent on boats. Since its ban, dog whelk populations have shown signs of recovery.

Endocrine disruption has been observed in fish taken from the Tees Estuary. Male flounders have shown signs of feminisation, but the cause is unknown. The Agency has undertaken a review of all scientific evidence for hormone disruption in wildlife and has identified priority substances for which EQS's are being developed. It is also working with other organisations to address gaps in knowledge and a four year collaborative programme of research called 'Endocrine Disruption in the Marine Environment' (EDMAR) is being undertaken with DETR, MAFF, SNIFFER and industry. The Tees will feature in this study.

Recommendations

The Agency will:

- **monitor the input of endocrine disrupting substances into the estuary**
- **work with industry to reduce the input of priority substances**
- **co-operate with the EDMAR Research Programme to better understand the issue and fill gaps in existing knowledge**

Global Climate Change and Sea Level Rise

It is unclear whether global warming is the result of natural climatic change (caused by fluctuations in the earth's orbit around the sun and changes in the degree of axis tilt), industrial pollution, or both. It is clear however, that global warming is proceeding. Records show that increases of between 0.3 – 0.6° C have occurred in the last 100 years, the consequences of which are reduction in the extent and volume of the polar ice caps and other land ice, therefore releasing water to the oceans. The changes in sea level noted along the coast of Teesside in the recent past are exclusively the result of global sea level rise since isostatic readjustment following the last ice age is neutral along an axis between Middlesbrough and Bangor in North Wales. Until recently, the rate of rise along the North East Coast was believed to be 2.1mm per year, but the Commons' Agriculture Committee report in 1998, 'Flood and Coastal Defences' has now increased this to 4mm per year.

Increased wave activity is evident around the UK coast and, coupled with a rise in sea level, the implication is for greater erosion within the Tees Estuary and an increase in the landward transport of coarse marine sediments. This means that sea level rise is going to be a major issue for the low-lying land around the Tees Estuary in the medium term.

Locations and Structures Under Threat

Most of the land adjacent to the Tees is already vulnerable to flooding. Inter-tidal mudflat reclamation has removed much of the natural buffer strip of coastal defence. Such features, together with beaches, when in a state of dynamic equilibrium with their environment, offer a very efficient means of dissipating tidal and wave energy. Upgraded tidal defences located at Greatham Greek and on Greenabella sea wall now afford protection against a one in 100 year flood, based on current knowledge.

However, other locations in the estuary face more immediate threat. North and South Gare Breakwaters owned by THPAL, were constructed in 1891 to improve navigation and protect the estuary from storm waves. Since construction, sand dunes, dune slacks and saltmarsh have established and these features could be lost if a breach occurs. Bran Sands Islands are now almost totally eroded. These dredged spoil islands previously offered roosts for knot and other wading birds. Today they can only offer sheltered waters for water sports.

Seal Sands Training Wall currently helps maintain the largest remaining inter-tidal area of mudflats in the estuary, namely Seal Sands - an important feeding ground for migratory birds who thrive on the invertebrates living in the mud and fine silt. The training wall is crumbling and this will allow increased wave action on Seal Sands. There is concern that the size and distribution of sediment particles will change as a consequence. A coarsening of sediment is likely to occur due to the change in dynamics. There is uncertainly surrounding the exact cause, and some theories suggest factors independent of the wall could be contributing to an increase in sediment coarseness. Any coarsening of sediment will result in a change in invertebrate communities, which in turn will impact on the bird population.

The future of all these structures is in doubt as a consequence of environmental forces and existing management policies. It could be argued that Seal Sands is at the greatest risk and at the same time provides the most important habitat. A partnership approach between all relevant organisations could be the best way of preserving the training wall and preventing further loss of habitat.

Flood Defence and Coastal Protection

The terms 'flood or sea defence' and 'coast protection' attract different legislative provision because they refer to different things. Flood or sea defence refers to measures taken to help prevent flooding whilst coast protection means measures taken to alleviate the erosion of land and encroachment by the sea. The latter is most relevant to the Tees Estuary. The aim of the nation's coastal defence policy is to reduce the risk to people and the developed and natural environment by encouraging the provision of adequate and cost effective flood warning systems, encouraging the provision of adequate, technically, environmentally and economically sound and

sustainable flood and coastal defence measures, and discouraging inappropriate development in areas of risk from flooding or coastal erosion. A dramatic shift in Government attitude occurred in 1998 towards coast protection and sea defence and a policy of managed realignment is now proposed. Where inappropriate development has occurred, it should not be protected at public expense, leaving the onus on the land owner to protect his property. In such areas it should not be presumed that it will be economically justifiable to maintain the existing coastal defences and that it may be appropriate to restrict development.

Local Authorities on Teesside have continued to pledge a commitment to ensure sea defences are adequate, yet the local cost of coastal defences are financed ultimately by central government via the Revenue Support Grant which might not, in future, support this.

The Environment Agency has published a document outlining the policies it will adopt to protect floodplains (Policy and Practice for the Protection of Floodplains). Of particular relevance is policy statement FD-P8 which states: 'The Environment Agency will object to development proposals behind existing flood or sea defences where those defences are not of an appropriate standard for new development.'

Recommendations

The Agency will :

- **monitor the impact of global warming on the estuary through relative changes in sea level.**
- **support the reinstatement of the Seal Sands Training Wall in order to conserve habitat.**

Shipping

Ships in ports can create pressures on the environment. Accidental leakage of hydrocarbons to the atmosphere and oil spills from ships can be a significant source of pollution. There is a need for a co-ordinated emergency response plan for the Tees estuary and the Agency will contribute to its future development, responsibility for which currently rests with the Unitary Authorities and THPAL. Aerial emissions from ships' exhausts can impact directly on local air quality

generating sulphur dioxide and ground level nitrous oxides when ships are at berth. The environmental impact of ships' exhausts on Teesside's air quality has not, as yet, been established and is an issue still to be investigated. Currently, the Agency has no immediate plans to undertake this work.

Recommendation

The Agency will consider extending the scope of the Tees Estuary Strategy to include other environmental media.

ENVIRONMENTAL TARGETS

Although there are relatively few national standards and targets set in statute, there are, nevertheless, numerous different kinds of standards, many set in classification schemes. The UK has maintained a long held stance in Europe over the use of environmental quality standards and objectives as the basis for pollution control. The initiatives for member states to establish standards for substances came from the EU Dangerous Substances Directive although many of the standards themselves have been derived and agreed within each member state.

National Targets and Standards

Historically the Agency has used a non-statutory classification scheme developed by the National Water Council in the 1970's for the reporting of estuary water quality which aims to provide a measure based on dissolved oxygen concentrations, aesthetic and biological quality. It is highly subjective and does not encompass the subtle impacts of endocrine disrupting substances, for example. The Agency are developing better ways to classify estuary water quality to include nutrients, BOD, Ammonia, biology and aesthetics.

The results of applying the general quality assessment scheme to the Tees Estuary are shown in figure 12 and a dramatic improvement can be seen between 1970 and 1997 reflecting the benefits of reduced inputs of industrial and sewage effluents. This is a result of improvements in process technology, better plant management, waste minimisation and recycling schemes and the installation of effluent treatment systems, as well as plant closures.

Environmental Monitoring

Section 84 of the Water Resources Act 1991 places a duty on the Agency to 'monitor the extent of pollution in controlled waters'. This monitoring can be divided into three regimes – statutory requirements, general quality assessment and operational requirements. The elements are integrated to provide an overall picture of water quality.

The Statutory Monitoring Programme covers the requirements of EU Directives and other national and international commitments. Extensive environmental monitoring programmes are

carried out by the Agency to assess compliance with environmental quality standards in both fresh and tidal waters and the results reported to the DETR annually.

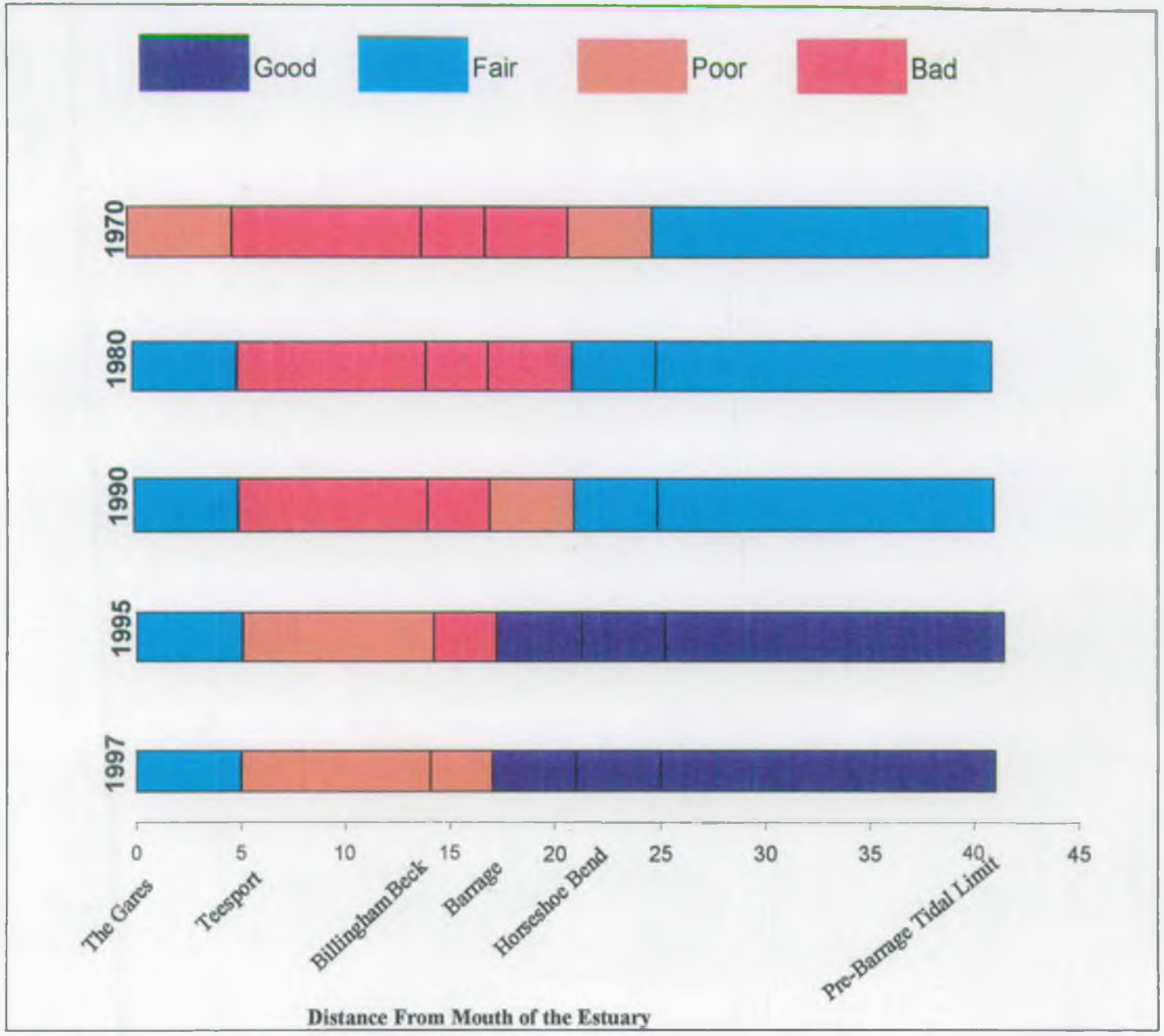
Estuarine waters receiving List I and II substances from point sources are monitored in the vicinity of the discharge for their presence either monthly or quarterly under the Dangerous Substances Directive and the results reported against the statutory EQSs or operational standards. Where EQSs are not achieved, an action plan must be developed to identify the discharges responsible and to initiate improvement actions.

The Agency monitors water quality every summer at designated bathing waters around the coast, to comply with the requirement of the EU Bathing Waters Directive. There are nine EU designated bathing beaches around the Tees Estuary. These are located at Seaton Carew (North and Central Beaches, North Gare), Redcar (Coatham Beach, 'Lifeboat Station', 'Sands' and 'Stray') and at Marske and Saltburn. The bathing season extends from May to September and each bathing water is sampled 20 times during this period (approximately weekly) mainly for bacteria indicating sewage contamination. Two sample failures or 'exceedances' cause the beach to fail the Directive mandatory standards.

Monitoring of water quality, sediments and benthic fauna and an assessment of fish population health is carried out under the Titanium Dioxide Directive in the immediate vicinity of the discharge into Greatham Creek from Tioxide UK Ltd's titanium dioxide manufacturing plant at Greatham. Further monitoring is performed at other reference sites further away from the influence of the discharge and include the Laing Basin, the Power Station water intake, Seaton Snook Light, Phillip's Approach and at a buoy in the Tees Channel known as the River Tees Control Site.

Under the Surveillance Monitoring Programme, fresh water quality in the River Tees is assessed, relative to the General Quality Assessment scheme, twelve times per year at Yarm Road Bridge and Victoria Bridge and in North Burn, Billingham Beck, Lustrum Beck, Stainsby Beck, Whitton Beck, Shotton Beck and in Greatham Creek and Greatham Beck.

Figure 12 .Tees Estuary Water Quality Classification



The Operational Monitoring Programme features the Lower Tees Survey, and monitoring sites included in this are located at Princess Diana Bridge, Tees Barrage, River Tees at confluence with the Old Tees, Newport Bridge, Haverton Hill, Transporter Bridge, Middlesbrough Dock, Redcar Jetty, Smith's Dock, Phillip's Approach and The Gares. The Lower Tees Survey takes place 12 times a year, once in each quarter. Samples are taken of surface, middle and bottom water. This survey incorporates the statutory monitoring programme for 'Dangerous Substances' (and daughter directives) and National Marine Monitoring Plan. The middle and bottom samples are taken to provide the Agency with information about general water quality trends and how stratification effects mixing of discharges. The Lower Tees Survey consists of discrete 'snapshot' samples subject to influence by events particular to the days when the survey is undertaken, for example tidal range, tidal state and recent rainfall, and it provides four 'snapshots' over the year.

This programme has recently been reviewed to enable resources to be better targeted to address particular water quality problems or issues. In order to provide more useful information for monitoring trends, the Agency has installed two fixed monitoring stations in the Upper Estuary. One is sited at Portrack Jetty, the other at Vulcan Street (close to the Transporter Bridge). Each station consists of two multi-parameter probes which rise and fall with the tide and collect physical data (dissolved oxygen, temperature, salinity, pH and turbidity every 15 minutes and which can be accessed on-line.

The quinquennial survey has been carried out every 5 years since 1970 as a collaborative venture between industry and the Agency. Vessels are usually stationed at 5 points on the river and measurements of physical parameters and current strength and direction, taken every half-hour over a 12.5 hour tidal cycle. The survey has historically taken place over three days on a spring tide and three days on a neap tide in summer. The next survey is due in 2000 and with ICI's diminishing presence on Teesside another lead organisation may now need to be identified.

Existing Tees Estuary Targets

The River Tees has been the focal point for environmental improvement on Teesside during the last 30 years and is beginning to recover from the chronic pollution from industry which started in the 1920s. In 1978, a Northumbrian Water Authority working party was established with a remit to examine the costs and social benefits of alternative control policies and as a result three targets were defined to tackle dissolved oxygen, un-ionised ammonia and cyanide levels:

	Oxygen		Ammonia
Target 1	DO present at all states of the tide		
Target 2	0.2mg/l min	3mg/l max	0.05mg/l max
Target 3	0.2mg/l min	5mg/l max	0.02mg/l max

Target 1

Any pollution control policy for the Tees Estuary had to include the removal of gross nuisance4 as its first target. Thus target 1 required the protection of public health, prevention of visual and smell nuisance, and maintenance of the upper estuary as a freshwater fishery and an amenity.

Target 2

The River Tees was formerly a renowned salmon and sea trout river, and so consideration was given to the possible restoration of a migratory fishery. Salmonids pass through the estuary twice during their life-cycle; first as young fish (smolt) when they migrate to the open sea, and then as adult fish returning to spawn. In this area, smolts usually migrate during April, May and early June, whereas runs of adult fish occur throughout the year. Target 2 required water quality to be suitable for the migration of smolts out to sea at certain states of the tide.

Target 3

The ultimate target for water quality was to allow the passage of migratory fish at all times.

New Objectives for the Tees Estuary

The Agency has recognised ongoing aspirations for the Tees Estuary and the importance of a healthy ecosystem, and considers it appropriate at this time to determine how further improvements to the estuary environment can be delivered and maintained. The question of what happens next will be addressed by the following objectives, targets and indicators which have been developed in consultation with those most likely to be affected.

The objectives are as follows:

- Encourage and maintain the passage of salmon and migratory sea trout smolts to sea and returning adults at all times
- Encourage and maintain the passage of eels and lampreys to and from sea during migration periods
- Encourage and maintain a healthy estuarine fish population that is consistent with the hydro-physical regime
- Encourage and maintain a healthy benthic flora and fauna that is consistent with the hydro-physical regime
- Encourage and maintain a healthy, breeding common seal colony at Teesmouth
- Maintain levels of waterfowl usage which contribute to the nationally and internationally important waterfowl populations of the Teesmouth and Cleveland Coast SPA/RAMSAR site
- Encourage and maintain the aesthetic quality such that pollution does not affect estuary usage or cause a public nuisance.

New Targets and Indicators

The table below identifies water quality targets for the two stretches of the estuary between Teesport and the Barrage and between Teesport and the Gares.

Table 30. Objectives, Targets and Indicators for the Tees Estuary

	Teesport to Barrage	Teesport to Gares
Dissolved Oxygen	Dissolved Oxygen of > or = 40% as a 05 percentile (salmon, sea trout) Surface dissolved oxygen of .>or = 30% as a 95 percentile (eels, lampreys) Bottom dissolved oxygen of >or = 40% as a 95 percentile (benthic fauna) Bottom dissolved oxygen of >or =45% as a 95 percentile (estuarine fish) Bottom dissolved oxygen of >or = 45% as a 95 percentile (benthic flora) Current oxygen regime Maintained as a minimum (waterfowl)	Dissolved Oxygen,of > or = 40% as a 05 percentile (salmon, sea trout) Surface dissolved oxygen of .>or = 30% as a 95 percentile (eels, lampreys) Bottom dissolved oxygen of >or = 40% as a 95 percentile (benthic fauna) Bottom dissolved oxygen of >or =45% as a 95 percentile (estuarine fish) Bottom dissolved oxygen of >or = 45% as a 95 percentile (benthic flora) Current oxygen regime Maintained as a minimum (waterfowl)
Ammonia	Un-ionised ammonia of 21 ug/l as a 95 percentile (salmon, sea trout) Total Ammonia of 780 ug/l (salmon, sea trout, estuarine fish) Surface un-ionised ammonia of 21 ug/l as a 95 percentile (eels and lampreys) Bottom un-ionised ammonia Of 21 ug/l as a 95 percentile (estuarine fish, benthic fauna and flora) Bottom total ammonia of 780 ug/l (estuarine fish, benthic fauna and flora)	Un-ionised ammonia of 21 ug/l as a 95 percentile (salmon, eels, lampreys) Total Ammonia of 780 ug/l (salmon, sea trout, estuarine fish) Surface un-ionised ammonia of 21 ug/l as a 95 percentile (eels and lampreys) Bottom un-ionised ammonia Of 21 ug/l as a 95 percentile (estuarine fish, benthic fauna and flora) Bottom total ammonia of 780 ug/l (estuarine fish, benthic fauna and flora)

	Current un-ionised ammonia levels maintained as a minimum (waterfowl)	Current un-ionised ammonia levels maintained as a minimum (waterfowl)
Nutrients	*To be developed*	*To be developed*
Aesthetics	No public complaints regarding the aesthetic quality of the estuary No increase in pollution incidents	No public complaints regarding the aesthetic quality of the estuary No increase in pollution incidents
Environmental Quality Standards	Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards	Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards
Temperature	<25C	<25C

The following environmental indicators provide measures to determine whether the goals and being achieved.

- Recorded presence of returning adult salmon and sea trout in the Tees Barrage fish trap
- Recorded presence of salmonids at the Hartlepool Power Station intake screens
- Recorded presence of eels at the Tees Barrage during migration periods
- Recorded presence of eels at the Hartlepool Power Station intake screens
- Recorded presence of lampreys at the Tees Barrage during migration periods
- Recorded presence of lampreys at the Hartlepool Power Station intake screens
- Recorded presence of flounder at trawl sites during summer and winter trawl surveys
- Recorded presence of two or more other fish species at all sites throughout the year
- For selected species of fish, body burdens of specific substances in lower category of MAFF guidelines
- Increase in number of algal species
- Percentage cover and thickness of macroalgae, e.g. *Enteromorpha*
- Stand still burdens of specific substances for the macroalgae *Fucus*
- Number of sites classified as polluted biotope
- Number of sites classified as speciose opportunistic biotope
- Number of sites classified as stable biotope
- Percentage area of rich intertidal biotope maintained
- Cockle population at Seal Sands classed as upholding with numerous age classes

- Stand still body burdens of substances for mussels, winkles and ragworms
- Annual comparisons with five-year mean peak populations of knot, redshank. shelduck, sanderling, ringed plover, sandwich tern, oyster catcher, curlew, common seal and grey seal
- Common seal population maintained at specified limits
- Successful breeding and survival of common seal pups
- Proportion of pups to survive for more than one year
- Number of unsubstantiated/major/minor pollution incidents
- Number of public complaints regarding aesthetics
- Media and public perceptions of the estuary

Recommendations

The Agency will:

- **Set long term environmental targets and indicators in collaboration with others having regard to cost and benefits**
- **Make information more widely available and understandable on progress towards achieving targets**
- **Review the Tees Environmental Monitoring Programme to ensure that it mets local, national and international needs and that monitoring is co-ordinated between all interested parties**
- **Initiate state of the environment reporting against the agreed new targets and indicators**
- **Initiate discussions with industry on the carrying out of a year 2000 and subsequent quinquennial surveys**

FUTURE DEVELOPMENTS

This section sets out to identify priorities for action and reviews planned or proposed developments and initiatives. These include new legislative proposals that will have a significant influence on the way the Tees Estuary environment is used and managed in the years ahead.

Sustainable Development

Sustainable development is now the main driver in environment policy development and is reflected in new legislative proposals within both Europe and the UK. It has become one of the European Community's main goals and environmental protection will be integrated into all of its policies through amendments to various Directives and Treaties. The UK Government is committed to achieving sustainable development and a consultation paper, 'Opportunities for Change', was issued in February 1998. A Sustainable Development Strategy is to be published soon which will have a wider social dimension.

In November 1998 a set of headline indicators of sustainable development were suggested for the UK. For the water environment it is proposed to monitor the percentage of river length of good or fair quality and it is recognised that the greatest challenges to the future management of the freshwater environment are posed by pressures caused by changing climate, changing lifestyles and increasing urbanisation.

New Legislative Initiatives

A draft 'Water Framework' Directive intended to become the cornerstone of EU water policy has been published by the European Commission. It respects many of the existing Directives on water pollution and provides a framework for improving fresh water quality and for the sustainable use of water resources. It is pioneering in that for the first time ecological objectives will be set. Key elements include a requirement that all waters achieve 'good' status by 2010 and that water management plans are drawn up for each river basin.

The implementation of the Integrated Pollution Prevention and Control (IPPC) Directive will have significant effect on the regulation of major installations by strengthening the existing

regulatory regimes. It covers emissions to air, land and water, as well as heat, noise and vibration, energy efficiency, environmental accidents and site production. The IPPC Directive is designed to prevent, reduce and eliminate pollution at source through the prudent use of natural resources and is intended to help industrial operators move towards greater environmental sustainability. The overall objective of the new regime is a high level of protection for the environment as a whole and it will be introduced into the UK from November 1999 through a system of permits.

A proposal has been made for a Directive on the inspection of industrial facilities, aimed at improving the enforcement of EU environmental laws and it is likely to apply to installations subject to the IPPC Directive. An integrated approach to inspections to examine the full range of environmental impacts is at the centre of the proposal requiring coordination between different inspectorates. In addition to compliance checking, an examination of each facility to identify necessary improvements will be required and inspectors will have to promote operators understanding of their environmental impacts.

As a competent authority under the Habitats Regulations 1994, put in place to implement the EU 'Habitats' Directive, the Agency has certain principal obligations with regard to Special Protection Areas (SPAs) and Special Areas for Conservation (SACs). The first is to comply with the aims of the Habitats Directive in exercising any of its functions, and to review existing Agency authorisations, plans or projects and assess whether they are likely to have a significant effect on an SPA or SAC. If so, the Agency will undertake an appropriate assessment to ascertain whether the activity is having an adverse effect on the integrity of the site in question. If there is an adverse effect, permissions will be amended or revoked, unless there are reasons of overriding public interest.

The Government announced a review of legislation relating to the Environment Agency in England and Wales and the Scottish Environment Protection Agency in April 1998. Its purpose is to identify barriers preventing the two regulatory bodies from adopting an integrated approach to the environment.

Significant changes to the water abstraction licensing system were proposed in June 1998. Recent droughts and the prospect of increased pressure on water resources from climate change have forced the issue of water abstraction licensing into the spotlight. Furthermore a report in 1996, following a House of Commons inquiry, urged a review of the system in place, which was felt to be inflexible, inefficient at distributing available resources and inadequate to prevent environmentally damaging abstractions.

Regulations to introduce new controls on discharges of dangerous substances to groundwater were introduced on 1 January 1999. The new rules are a response to the European Commission issuing a reasoned opinion against the UK in respect of it not using the Groundwater Directive to control the disposal of spent sheep dip. The regulations affect many more sources of groundwater pollution than farms, including a wide sector of industrial premises or operations that manufacture, handle, store or use List I or II substances, and where disposal of List I and II substances take place onto or into land.

Part IIA of the Environmental Protection Act 1990 (inserted by section 57 of Environment Act 1995) will introduce a new statutory regime for the identification and control of contaminated land. Regulations will be introduced from December this year to enable the primary statute, which will be enforced by the local authorities and the Agency, and which will require contaminated land to be remediated in accordance with the 'Polluter Pays Principle' where pollution of controlled waters is being caused or where it is causing, or likely to cause, significant harm.

Asset Management Planning (AMP) – The Periodic Review of Water Companies Capital Investment

In October 1996, the DoE and the Welsh Office published 'Water Resources and Supply - Agenda for Action', which set out a framework of action for the future provision of sustainable water supplies. It stated that the use of existing resources should be maximised through demand management, with a particular focus on the efficient use of water, the need for economic levels of leakage, and the application of charging arrangements which encourage further economy in the use of water resources.

More recently, in May 1997, the Government held a Water Summit which further endorsed the need for demand management measures, and at which the review of the water abstraction licensing system in England and Wales was initiated. The Agency has a key role to play in the development of a water efficient and environmentally sustainable water industry. It participates in the review of the prices charged by the water companies, ("The Periodic Review") carried out by the Director General of the Office of Water Services (OFWAT). This sets limits on the amount the water companies in England and Wales can charge their customers. The Agency must advise Government on the programme of environmental improvements which should be carried out by each water company to ensure that the UK meets its legal obligations, including those measures needed to improve water quality around UK coasts and in rivers and lakes. It is currently preparing itemised programmes for each water company up to 2005 and will assess the benefits to be gained, the cost of improvements, together with local and national priorities.

Guidance from the Deputy Prime Minister and Secretary of State for Wales to the Director General of Water Services on the environmental and quality objectives to be achieved by the water industry in England and Wales for the period 2000 – 2005 was published in September 1998. It acknowledges the case for further investment in the environment and responds to public concern by adopting a more precautionary approach that will ensure secondary treatment is the minimum treatment to be applied to significant coastal discharges.

Coastal sewage discharges under the control of Northumbrian Water Ltd. could have a significant influence on the compliance or otherwise of Teesside's beaches with bacterial standards in the Bathing Water Directive. The company's 'bathing water programme' was designed to eliminate this source of potential non-compliance. The programme of preliminary sewage treatment and long sea outfalls was completed in 1996 and secondary treatment at Seaton Carew and Marske will be completed by 2000.

The Government has agreed to at least double the current rate of progress on correcting unsatisfactory intermittent discharges, which means that a minimum two-thirds of unsatisfactory

discharges in 2000 will be improved by 2005. On Teesside, the impact of storm overflows is not a significant influence on water quality.

Tees Estuary Operational Improvements

The Northumbrian Water Limited Tees Estuary Environmental Scheme (TEES) and the Regional Sludge Treatment Centre are two major capital investment projects currently under construction at Bran Sands, an area of land within the Wilton chemical complex totalling approximately 21 hectares. The site was previously used for the disposal of a wide range of chemical and industrial wastes and required extensive engineering works and the installation of a protective membrane to separate the buried waste from the surface construction. When complete the schemes will provide wastewater treatment for Teesside and a facility for the disposal of sewage sludge from the north-east of England. It will represent £200 million of capital investment.

TEES is a £140 million scheme to provide a modern industrial and municipal wastewater treatment facility with associated sewerage infrastructure and will bring significant benefits to the River Tees by ending the discharge of partially treated sewage and therefore improving water quality. A new effluent treatment works (ETW) is being built in phases that will ultimately treat a flow of up to 260,000 m3 per day and a load of up to 140 tonnes BOD. This is equivalent to a population of 3.5 million.

Municipal sewage from the existing Portrack sewage treatment works is pumped to the new facility through pipelines on the northern and southern banks of the river. The northern pipeline will be transferred to Bran Sands via an existing river tunnel. Separate pipelines will transfer industrial effluents from Dupont at Wilton and from British Steel at Redcar.

The Regional Sludge Treatment Centre is unique in the North East and is being constructed adjacent to TEES. When complete, it will provide a sewage sludge disposal facility serving a population of 2.6 million and eventually treating 90,000 tonnes dry solids per year by 2003. Raw sludge will be transported from other ETWs in the region (mainly by ship) to a newly constructed jetty serving the site. It will be dewatered and dried to raise the dry solids content

from 5% to 95% and used to produce a biopellet product which can be used in agriculture, forestry, brick manufacture, or be burned as fuel to generate electricity.

Northumbrian Water Limited intends to use gasification technology to recover the maximum energy from the dried sludge and plans to build a single reactor process stream to generate 5MW of electricity. The gas produced from the biopellets will fire a gas turbine and provide power to supply the drying plant, making the site self-sufficient in energy.

New Environmental Initiatives

Direct Toxicity Assessment (DTA) is a term given to the toxicity assessment of a whole effluent on receiving water, taking into account the additive, antagonistic and synergistic effects of all the substances present. The Agency, together with the Scottish Environmental Protection Agency and the Department of the Environment in Northern Ireland, is working with industry to develop procedures for the use of DTA as a 'tool' for water quality management alongside substance specific measures and biological assessment techniques.

Following a consultation exercise in 1996, industry expressed the view that there was a need to demonstrate that DTA is a cost effective driver of environmental improvement. It was suggested that this could be best achieved by means of a collaborative demonstration project in which a protocol would be tested at selected sites.

Four locations were originally proposed and a project plan prepared for each site. The locations were:

River Esk - South West Scotland

Tributary of River Spey – North East Scotland

River Aire – West Yorkshire

Lower Tees Estuary – Teesport to Teesmouth (a 5.5km stretch)

The Esk and the Aire projects commenced early in 1998 and the Tees in Autumn 1998. The River Spey project did not proceed. The programme is to establish how DTA can best contribute to sustainable development through better targeted investment in maintaining and improving

water quality and make recommendations on how best to implement DTA through a tried and tested protocol and set of procedures. It is proposed that DTA will be used on a prioritised basis to help improve receiving waters where toxicity is perceived to be a significant contributory cause of poor ecological quality and to protect all receiving waters from the threat of toxicity from new discharges.

The study on the Tees was completed in May 1999 and included toxicity measurements in the estuary and the screening of discharges for toxicity. The use of the Tees 3-D dilution and dispersion model enabled an initial assessment of the contribution of these discharges to any measured toxicity in the receiving water to be carried out.

Appendix 1

Table A1.1 Objectives, Targets and Indicators for the Tees Estuary - Barrage to Teesport

Stretch	Objectives	Targets	Indicators	Comments
Barrage to Teesport	Encourage and maintain the passage of salmon and migratory sea trout smolts to sea and returning adults at all times	Dissolved oxygen of >/= 40% as a 95 percentile <25 °C Unionised Ammonia 21 µg/l as a 95 percentile Total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of returning adult salmon and sea trout in the Tees barrage fish trap Recorded presence of salmonids at the Hartlepool Power Station cooling water intake screens	This objective will be revised following the implementation of the Salmon Action plan for the Tees and installation of adequate fish counting facilities at the Tees Barrage Measures for effort based rod catch returns will be developed as a future indicator .
	Encourage and maintain the passage of eels to and from sea during migration periods	Surface dissolved oxygen of >/= 30% <25 °C Surface unionised Ammonia 21 µg/l as a 95 percentile Surface total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of eels at the Tees Barrage during migration periods	The lower dissolved oxygen standard for eels reflects there reported tolerance of lower dissolved oxygen levels in the Elbe estuary (Thiel et al, 1995)

Stretch	Objectives	Targets	Indicators	Comments
	Encourage and maintain the passage of lampreys to and from sea during migration periods	Surface dissolved oxygen of >/= 30% as a 95 percentile <25 °C Surface unionised Ammonia 21 µg/l as a 95 percentile Surface total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of lampreys at the Tees Barrage during migration periods	
Barrage to Teesport cont=d	Encourage and maintain a healthy estuarine fish population that is consistent with the hydro-physical regime	Bottom dissolved oxygen of >/= 45% as a 95 percentile <25 °C Bottom unionised Ammonia 21 µg/l as a 95 percentile Bottom total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of flounder at all suitable trawl sites during summer and winter trawl survey Recorded presence of one other estuarine resident species at trawl sites during year. For selected species of fish, body burdens of specific substances in lower category of MAFF guidelines	There is a need to establish the viability of the Tees estuary flounder population since the introduction of the Tees barrage. Presence indicators will be reviewed as expected improvements occur.

Stretch	Objectives	Targets	Indicators	Comments
	Encourage and maintain a healthy benthic flora that is consistent with the hydro-physical regime	Bottom dissolved oxygen of >/= 40% as a 95 percentile <25 °C Bottom unionised Ammonia 21 µg/l as a 95 percentile Bottom total Ammonia of 780 µg/l Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Increase in number of algal species % cover and thickness of *Enteromorpha* (macroalgae)	Heriott Watt University regularly collect data on the number of attached algal species present in the estuary. The North Tees mudflat is not presently affected by excessive growth of macroalgae.
	Encourage and maintain a healthy benthic fauna that is consistent with the hydro-physical regime.	Bottom dissolved oxygen of >/= 40% as a 95 percentile <25 °C Bottom unionised Ammonia 21 µg/l as a 95 percentile Bottom total ammonia of 780 µg/l Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	No. of sites surveyed classified as polluted biotope. No. of sites surveyed classified as speciose opportunistic biotope Standstill body burdens of specific substances in winkles and ragworms	Benthic invertebrate fauna feature as part of ongoing statutory monitoring.

Stretch	Objectives	Targets	Indicators	Comments
	Maintain levels of waterfowl usage which contribute to the internationally and nationally important waterfowl populations of the Teesmouth and Cleveland Coast SPA/RAMSAR site	Current dissolved oxygen regime maintained as a minimum Current unionised ammonia levels maintained as a minimum Compliance with EC Dangerous Substances Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	% area of rich intertidal biotope maintained % cover and thickness of *Enteromorpha* (macroalgae) Annual comparisons with five-year mean peak populations of species Ax≡ (see Table 3 for species and numbers) maintained within specified limits	
	Encourage and maintain the aesthetic quality such that pollution does not affect estuary usage or cause a public nuisance	No public complaints regarding the aesthetic quality of the estuary No increase in pollution incidents	Number of unsubstantiated/ major/ minor pollution incidents	The Middlesborough Access Project is promoting a south bank footpath to increase access to the estuary frontage. Opportunities may exist to target visitors to this area for future aesthetic indicators. A Barrage questionnaire may also be devised for future indicator measures as well as gauging public perceptions of the estuary

Table A1.2 Objectives, Targets and Indicators for the Tees Estuary - Teesport to Gares

Stretch	Objectives	Targets	Indicators	Comments
Teesport to Gares	Encourage and maintain the passage of salmon and migratory sea trout smolts to sea and returning adults at all times	Dissolved oxygen of >/= 40% as a 95 percentile <25 °C Unionised Ammonia 21 µg/l as a 95 percentile Total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of returning adult salmon and sea trout in the Tees barrage fish trap Recorded presence of salmonids at the Hartlepool Power Station cooling water intake screens	This objective will be revised following the implementation of the Salmonid Action plan for the Tees and installation of adequate fish counting facilities at the Tees Barrage Measures for effort based rod catch returns will be developed as a future indicator
	Encourage and maintain the passage of eels to and from sea during migration periods	Dissolved oxygen of >/= 30% as a 95 percentile <25 °C Unionised Ammonia 21 µg/l as a 95 percentile Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of eels at the Tees Barrage during migration periods Recorded presence of eels at the Hartlepool Power Station cooling water intake screens	

Stretch	Objectives	Targets	Indicators	Comments
	Encourage and maintain the passage of lampreys to and from sea during migration periods	Dissolved oxygen of >/= 30% as a 95 percentile <25 °C Unionised Ammonia 21 µg/l as a 95 percentile Total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of lampreys at the Tees Barrage during migration periods Recorded presence of lampreys at the Hartlepool Power Station cooling water intake screens	
	Encourage and maintain a healthy estuarine fish population that is consistent with the hydro-physical regime	Bottom dissolved oxygen of >/= 45% as a 95 percentile <25 °C Unionised Ammonia 21 µg/l as a 95 percentile Total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards (see Table 1.3 for standards)	Recorded presence of flounder at trawl sites during summer and winter trawl survey Recorded presence of 2 or more other fish species at all sites throughout year. For selected species of fish body burdens of specific substances in lower category of MAFF guidelines	There is a need to establish the viability of the Tees estuary flounder population since the introduction of the Tees barrage. To be reviewed as estuary is expected to improve.

Stretch	Objectives	Targets	Indicators	Comments
	Encourage and maintain a healthy benthic flora that is consistent with the hydro-physical regime	Dissolved oxygen of >/= 40% as a 95 percentile <25 °C Unionised Ammonia 21 µg/l as a 95 percentile Total Ammonia 780 µg/l Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards	Increase in number of algal species The growth of the macroalgae, *Enteromorpha* does not exceed 25% coverage of the intertidal mudflats at Seal Sands Stand-still burdens of specific substances for the macroalgae *Fucus*	Heriott-Watt University regularly assess the diversity of algal species *Fucus* body burdens can be compared to ADRIS guidelines with a view to maintaining background levels in the longer term for specific substances.
	Encourage and maintain a healthy benthic fauna that is consistent with the hydro-physical regime.	Current dissolved oxygen regime maintained as a minimum Current unionised ammonia levels maintained Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards	No. of sites classified as polluted biotope No. of sites classified as stable biotope Cockles population at Seal Sands classed as upholding with numerous age classes Stand-still body burdens of specific substances for mussels, winkles and ragworms	Benthic invertebrate fauna feature as part of ongoing statutory monitoring and are likely to be a feature of further Directive monitoring requirements in the future. Cockle target based on Astate≡ model for cockles (Ducrotoy et al, 1989) Mussel body burdens can be compared to ADRIS guidelines with a view to maintaining background levels in the longer term for specific substances.
	Encourage and maintain a healthy, breeding common seal colony at Teesmouth	Current dissolved oxygen regime maintained as a minimum Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards	Common Seal population maintained at specified limits Successful breeding and survival of Common Seal pups. Proportion of pups to survive beyond first year.	Current regime of low DOs, high nutrients has not impaired increases in seal population at Seal Sands. Studies on the content of the colony=s faeces in 1998 will provide further information on the feeding habits of the seals

Stretch	Objectives	Targets	Indicators	Comments
	Maintain levels of waterfowl usage which contribute to the internationally and nationally important waterfowl populations of the Teesmouth and Cleveland Coast SPA/RAMSAR site	Current dissolved oxygen regime maintained as a minimum Current unionised ammonia levels maintained as a minimum Compliance with EC Dangerous Substances Directive, Titanium Dioxide Directive and Red List Standards and other UK operational standards Prevent adverse environmental impact arising from the growth of algal mats	% area of rich intertidal biotope maintained % cover and thickness of *Enteromorpha* (macroalgae) Annual comparisons with five-year mean peak populations of species (see Table 3 for species and numbers) maintained within specified limits	Links between bird numbers and impact of algal matts requires further monitoring. Indicators to be developed as knowledge of cause and effect relationship improves. Currently no adverse effect on bird numbers
	Encourage and maintain the aesthetic quality such that pollution does not affect estuary usage or cause a public nuisance	No public complaints regarding the aesthetic quality of the estuary No increase in pollution incidents	Number of public complaints No of unsubstantiated/ major / minor pollution incidents Media and public perceptions of the estuary	Questionnaires could be devised for this stretch for visitors to the A Teesmouth Field Centre Barrage questionnaire may also be devised for future indicator measures as well as gauging the public perceptions of the estuary Public perceptions of the estuary may be gauged with questionnaires as a future indicator

Appendix 2

Table A2.1 List I and II Saline Environmental Quality Standards

List	Substance	Annual Average µg/l	Maximum Allowable Concentration
I (Statutory)	Mercury*	0.3D	
	Cadmium*	2.5D	
	Hexachlorocyclohexane*	0.02	
	Carbon Tetrachloride	12	
	p,p DDT*	0.01	
	Total DDT*	0.025	
	Pentachlorophenol*	2	
	Total Adrins≡*	0.03	
	Aldrin*	0.01	
	Dieldrin*	0.01	
	Endrin*	0.005	
	Isodrin*	0.005	
	Hexachlorobenzene*	0.03	
	Hexachlorobutadiene*	0.1	
	Chloroform	12	
	1,2 Dichloroethane	10	
	Trichloroethylene	10	
	Perchloroethylene	10	
	Trichlorobenzene	0.4	
Old List II (Agency Mandatory)	Lead	25D	
	Chromium	15D	
	Zinc	40D	
	Copper	5D	
	Nickel	30D	
	Arsenic	25D	
	Boron	7000	

	Iron	1000D	
	pH	6-8.5	
	Vanadium	100	
	PCSD=s	0.05P	
	Cyfluthrin	0.001P	
	Sulcofron	25P	
	Flucofron	1P	
	Permethrin	0.01P	
	Tributyltin	0.002	
	Triphenyltin	0.008	
List	**Substance**	**Annual Average µg/l**	**Maximum Allowable Concentration**
New List II statutory regulated standards (Spring 1998)	Arsenic	25	-
	Dichlorvos	0.04	0.6 (24 hours after application)
	Atrazine and Simazine	2 (total combined)	-
	Azinphos-methyl	0.01	-
	Endosulphan	0.003	-
	Fenitrothion	0.01	-
	Malathion	0.02	-
	Trifluran	0.1	-
	Triphenyltin and its derivatives	-	0.008
	Tributyltin	-	0.002
	4-Chloro-3-methyl phenol	40	200
	2-Chlorophenol	50	250
	2,4- Dichlorophenol	20	140
	2,4-D (ester)	1	10
	2,4-D (non-ester)	40	200
	1,1,1-Trichloroethane	100	1000
	1,1,2-Trichloroethane	300	3000
	Bentazone	500	5000
	Benzene	30	300

	Biphenyl	25	-
	Chloronotrotoluenes	10	100
	Demeton	0.5	5
	Dimethoate	1	-
	Linuron	2	-
	MCPA	2	20
	Mecoprop	20	200
	Mevinphos	-	-
	Napthalene	5	80
	Omethoate	-	-
	Toluene	40	400
	Triazaphos	0.005	0.05
	Xylene	30	300
Non regulated at present	Nonyl-phenols	???	???

Standards are for Total, unless indicated by D for dissolved

***Sediment A Standstill provision applies to these List I substances, p = 95% of samples**

Appendix 3

Environmental Legislation

The following section identifies the main requirements of European Directives and related initiatives affecting the water environment.

Dangerous Substances Directive 1976 76/464/EEC

The aim of this 'framework' Directive on 'pollution caused by the discharge of dangerous substances on the aquatic environment' is to seek the elimination of the discharge of the most dangerous substances in terms of their persistence, toxicity and bio-accumulation and which are listed in appendix I to the Directive. The 17 'List I' substances have had Environmental Quality Standards (EQSs) assigned by the EU which are concentrations to be met in receiving waters.

Other less dangerous substances are contained in appendix II to the Directive and the setting of appropriate EQSs has been left to individual Member States. The objective here is to limit the discharge of these substances into the environment.

Control of List I and II substances in the water environment is exercised through conditions attached to 'consents to discharge' issued by the Environment Agency under the Water Resources Act 1991 and through Agency monitoring programmes to assess consent compliance and the quality of receiving water in relation to the EQSs. During March 1998 the UK Government brought within regulation a number of new List II substances, many of which are pesticides or chemical intermediates used in manufacturing industry.

The Red List

The 'Red List' was announced by the UK Government in 1989 and consists of 23 substances and groups of compounds considered to pose the greatest hazards to the aquatic environment by virtue of their toxicity, persistence or tendency to accumulate in food chains.

Many of the major point source discharges of Red List substances are now regulated under Integrated Pollution Control. All 23 were statutorily prescribed for this purpose in 1991.

A nationwide monitoring programme for discharges was drawn up which defined the loads of Red List substances and the DoE set a national 50% load reduction target for the substances over the 1985-95 period. This was largely achieved on Teesside through Dangerous Substances and Red List initiatives and the issue of discharge consent conditions.

At present there are no firm plans to extend the programme to other substances or revisit the 1985-95 load reduction exercise although it has been suggested that such an initiative may be considered if appropriate in the future.

Urban Waste Water Treatment Directive 1991 (91/171/EEC)

The EU Directive on Urban Waste Water Treatment (UWWTD) established secondary treatment as the norm for sewage works treating population equivalents of over 15,000, and called for action on eutrophication through the designation of 'sensitive areas'. In such locations, nutrient removal from sewage effluents is required at works with a discharge greater than 10,000 population equivalent.

Under the UWWTD the general requirement is for secondary treatment by 31 December 2000 for all discharges greater than 15,000 population equivalent. In addition, secondary treatment is required by 31 December 2005 for discharges into coastal waters of between 10,000 and 15,000 population equivalent.

For discharges of 2,000 to 15,000 population equivalents into fresh waters and estuaries, secondary treatment is required by 31 December 2005. For discharges of less than 2,000 population equivalent to freshwater and estuaries, or less than 10,000 population equivalent into coastal waters which enter a collecting system, 'appropriate treatment' is required by 31 December 2005. The level of treatment considered appropriate is determined by the Agency.

Under the UWWTD, where it can be shown through 'comprehensive studies' that estuaries or coastal waters do not exhibit eutrophication, possess good levels of dissolved oxygen and exhibit good dispersion then these waters can receive a derogation to primary treatment under articles 6.2 and 8.5 to the Directive.

Finally, the UWWTD brought an end to the dumping of sewage sludge at sea. In the UK, the higher level of treatment brought about by UWWTD means larger volumes of sludge will arise for disposal, the majority of which is likely to be disposed of to land after 31 December 1998 when the ban begins.

In February 1998 the House of Commons Environment Committee urged that all sewage should be fully treated and disinfected before discharge to inland or coastal waters. It made a further recommendation that by the year 2000, all sludge recycled to land be subject to stabilisation and pasteurisation and that both policy and practice relating to sewage sludge to land be based on the sustainable use of soil.

The Government in its response, stated that it considers that recovering value from sewage sludge through spreading on agricultural land is the best practical environmental option for sludge in most circumstances and is preparing a soil protection strategy.

The Bathing Waters Directive 1976 (76/160/EEC)

Designated beaches, regularly used by the public for bathing purposes must comply with the microbiological standards set by the Bathing Waters Directive. A bathing season sampling programme assesses compliance and where repeated failures arise because of inadequate sewage

treatment, improvement plans are required. In recent years this directive has driven significant investment by the water companies.

The Groundwater Directive 1980 (80/68/EEC)

The key requirements of this Directive are that the introduction of the most hazardous 'List I' substances into groundwater is prevented, while introduction of 'List II' substances must be limited so as to prevent pollution.

The Drinking Water Quality Directive 1980 (80/778/EEC)

Here Member States duties are to meet standards laid down for around 60 chemical, physical and biological parameters and ensure compliance with monitoring and analytical requirements. Derogations are possible where breaches in standards are attributable to geological or exceptional meteorological conditions but not for toxic or microbiological parameters.

The Freshwater Fish Directive 1978 (78/659/EEC)

Where freshwater rivers are designated as salmonid or cyprinid, water quality must meet the directive standards. The upper river Tees is designated as salmonid.

Nitrate from Agricultural Sources Directive 1991 (91/676/EEC)

This requires Member States to identify estuarine, coastal and marine waters potentially or actually affected by pollution from nitrates. Areas of land contributing to the problem are designated 'nitrate vulnerable zones'.

The 'Shellfish' Directives 1979 and 1991(79/923/EEC and 91/492/EEC)

The 1979 Directive obliged Member States to designate coastal waters or estuarine waters as shellfish waters and laid down water quality standards to protect shellfish growth in the designated areas. In response, the UK designated 29 areas as shellfish waters in 1981 and 1983 but the DoE relied on administrative rather than legal measures to implement the Directive.

A second Directive agreed in 1991 aimed to protect shellfish consumers by setting chemical and bacteriological standards for live bivalves and required classification of all shellfish production areas according to their water quality, banned commercial harvesting from the poorest waters and required purification of bivalves from intermediate waters.

The Titanium Dioxide Directives (78/176/EEC, 82/883/EEC, 83/29/EEC and 92/112/EEC)

These directives concern the prevention and progressive reduction of pollution caused by waste from the Titanium Dioxide industry. There are three titanium dioxide plants in the UK and the single Teesside operation uses the cleanest technology with limited environmental impact.

The Wild Birds Directive 1979 (79/409/EEC)

A general duty is placed on Member States to maintain the population of all species of naturally occurring birds in the wild state at a level corresponding to particular ecological, scientific and cultural requirements and taking into account any economic or recreational needs.

In addition, sufficient diversity and areas of habitat for birds should be preserved, maintained or re-established by creating protected areas, re-introducing destroyed biotopes and managing habitats both inside and outside protected areas.

Special Protection Areas (SPA's) were established to conserve habitats of rare or vulnerable species and regularly occurring migratory species. In the UK, these are already notified as SSSI's under the Wildlife and Countryside Act 1981.

Habitats Directive (92/43/EEC)

The Directive on 'Conservation of Natural and Semi Natural Habitats and of Wild Fauna and Flora' introduced special conservation measures for habitats of certain types and supporting certain rare species and also to maintain rare species and to protect threatened habitats.

Integrated Pollution Prevention & Control Directive 1996 (96/61/EEC)

The primary purpose of this Directive is to prevent or reduce emissions to the air, water and land from potentially polluting industrial installations so as to achieve a high level of protection of the environment as a whole. The Directive is due to be implemented in October 1999. Activities within the scope of the Directive include energy industries, the mineral industry including cement and glass works, the chemical industry, some waste management activities, food and drink processing sites, intensive agricultural units and tanneries and slaughterhouses.

Best available techniques must be used in taking all appropriate preventable measures against pollution and in addition, installations will be expected to minimise waste, conserve energy, prevent accidents and limit their environmental consequences, and ensure site clean-up when activities cease. IPPC will use a system of permitting and these permits will specify plant operating conditions, emission limit values for certain substances to air, land and water and the annual reporting of releases.

The requirements for public consultation and access to environmental information will remain similar to those of IPC processes regulated under the Environmental Pollution Act 1990 and it is expected that installations holding an IPC authorisation will not be required to maintain both types of permit. There will be a transition from the IPC regime to that operating under IPPC by October 2007.

International Commitments

In addition to European Union Directives, there are several international commitments to which the UK is a signatory. Some of these require the routine taking and analysis of environmental samples in order to determine progress towards agreed targets for reducing the amounts of contaminants entering the environment. A summary is given below:-

The Paris Commission

The Paris Commission (PARCOM) is responsible for administering the implementation of the 'Convention for the Prevention of Marine Pollution from Land-Based Sources' (The Paris Convention, 1974). The Convention lists four categories of pollutants and sets out the requirements for pollution reduction and elimination. In 1988 agreement was reached amongst member states who were signatories to the Convention, to undertake a comprehensive study of marine inputs of certain substances into the sea.

The North Sea Conference Declarations

These resulted in member states who are signatories to the Declarations, making regular estimates of the loads of certain substances entering their coastal waters from various land-based sources. This provided an overview of loads being discharged to the North Sea.

The Esbjerg Declaration

In 1995 the Esbjerg declaration set a long-term goal of reducing concentrations of hazardous substances in the marine environment to 'close to zero'.

The New Amsterdam Treaty

This treaty signed by heads of state in 1997, continued the process of strengthening EU environmental policy commenced by the Single European Act of 1986 and continued by the 1992 Maastricht Treaty.

EC Common Fisheries Policy

Charges the Ministry of Agriculture, Fisheries and Food (MAFF) with the task of sustaining fish stocks in coastal and offshore waters through the regulation of vessel size, fishing gear types and the proportion of stock which can be caught.

UK Legislation

Water Quality

Water Resources Act 1991

Part 3 of the Act provides the Agency with powers to control the direct and indirect discharge of the majority of trade and all sewage effluent into controlled waters by way of a consenting system. This Act also consolidates the provisions of the Water Resources Act 1963 in respect of the control of abstractions from groundwater. In addition, it provides powers to designate Nitrate Sensitive Area and statutory water protection zones.

The Environmental Protection Act 1990

Part 1 of EPA 90 relates to the application of Integrated Pollution Control to designated industries and the granting of authorisations by the Agency. Best Available Techniques Not Entailing Excessive Cost (BATNEEC) is used to prevent and minimise the release of prescribes substances and render harmless all substances whilst taking into account the Best Practical Environmental Option (BPEO).

Water Industry Act 1991

Regulations under this Act enable the monitoring and enforcement of quality standards in water used for private supply. Local authorities maintain a register of sources.

Fisheries

Sea Fisheries

Sea Fisheries Regulation Act 1966

Charges the North Eastern Sea Fisheries Committee (NESFC) and the Environment Agency with the authority to manage sea fisheries out to six nautical miles.

Sea Fisheries (Wildlife Conservation) Act 1992

In discharging its functions, the NESFC must strive to balance the needs of conservation and other issues.

Sea Fisheries (Shellfish) Act 1967

Requires MAFF to regulate the cultivation and management of specific shellfish. MAFF also possess a research programme with the objective of achieving sustainable stocks and to prevent shellfish stock exploitation.

Freshwater Fish including Salmonids

Environment Act 1995

Provides the Environment Agency a statutory duty to maintain, improve and develop salmon, trout, freshwater and eel fisheries.

Salmon and Freshwater Fisheries Act 1975 and the Water Resources Act 1991

The two Acts above confer the Agency with the duty to carry out the above.

Salmon Act 1986

Confers a duty upon the Environment Agency and Sea Fisheries Committees to work in partnership to protect salmon fisheries. In fulfilling this duty the committees can draw up bye-laws to do so. The Agency can subsequently enforce them.

Conservation

Wildlife and Countryside Act 1981

The Wildlife and Countryside Act as amended, provides the cornerstone for nature conservation in the UK. In addition to detailing procedures with regard to Sites of Special Scientific Interest (SSSI's), this Act gives protection to certain species.

The Conservation of Natural Habitats and Countryside Regulations 1994

This is the most significant piece of nature conservation legislation since the Wildlife and Countryside Act 1981. It introduces special conservation measures for habitats of certain types and supporting certain rare species. It also sets out a general requirement to maintain rare species and protect threatened habitats.

The Environment Act 1995

A general duty is placed on the Agency to promote the conservation and enhancement of the natural beauty and amenity of inland and coastal waters and the conservation of flora and fauna dependant on the aquatic environment.

APPENDIX 4

Releases to Water 1997

The operators of Authorised Processes are required to report to the Agency their annual releases to the environment. Listed below are those releases to the water environment made by industries situated around the Tees Estuary during 1997. NB The following figures are based upon information provided to the Environment Agency by individual companies. There are figures quoted elsewhere in this document for the outfalls RTO 1 and Wilton Site based upon Environment Agency water quality monitoring that differ from the corresponding figures below (differing sample frequencies may be attributable). This fact highlights an area for future attention and development.

Company	Authorisation	Outfall	BOD Tonnes	Ammonia Tonnes
ICI	AN8321	RTO1	198	338
ICI	AM7265	RTO1	23	158
ICI	AF7231	RTO1	12	-
ICI	AK7825	RTO1	20	-
Terra	AL7561	RTO1	-	12
Zeneca	AN7961	RTO1	39	-
Zeneca	AH2389	RTO1	73	42
		TOTAL	**365**	**508**
ICI	AO2175	BBO3	-	121
ICI	AM7265	BBO6	247	283
Terra	AL7553	BBO9	1	366
		TOTAL	**248**	**770**
BP	AK7418	Wilton	3	-
Dupont	AK3803	Wilton	5958	55

ICI	AK8236	Wilton	540	-
ICI	AK7868	Wilton	455	-
ICI	AK7841	Wilton	50	100
ICI	AK7728	Wilton	7797	-
ICI	AK6969	Wilton	260	-
ICI	AF7240	Wilton	36	-
ICI	AW5069	Wilton	12.5	0.5
Air Products	AW4194	Wilton	0.002	
Targor	AK6993	Wilton	0.011	-
Union Carbide	AK6845	Wilton	427	-
Union Carbide	AK6837	Wilton	20	13
		TOTAL	**15,727.5**	**938**
Hampshire Chemicals	AO0237	Hampshire Chemicals	88	10
Lundbeck	AM7621	Lundbeck	40	-
Seal Sands Chemicals	AL6956	Seal Sands Chemicals	9	-
Albermale UK Ltd	AK3684	Albermale UK Ltd	82	-
BASF	AJ6505	BASF	836	847
Fine Organics	AG8578	Fine Organics	26	-
British Steel	AF8548	Redcar Coke Ovens	171	76
British Steel	AF8530	SLEMS (C3)	171	1,715

Phillips Petroleum	AF4836	Phillips Petroleum	447	-
Zeneca DTBA	AL1482	Zeneca DTBA	1000	-
Bitmac	AJ7290	Bitmac	-	-
Tioxide	AL8363	Tioxide Greatham	-	-
ICI	AF8319	North Tees	169	-
		TOTAL	**3039**	**2648**

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For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY GENERAL ENQUIRY LINE
0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY EMERGENCY HOTLINE
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