Report of the

MILFORD HAVEN WATERWAY ENVIRONMENTAL MONITORING STEERING GROUP

1st April 1997 – 31st March 1999

INDEX

Contents **Page nos.**

Chairman's Forward

I will have retired from my post as Head of Public Health and Environment, with Pembrokeshire County Council by the end of March 1999, and will therefore be relinquishing my place on the Group.

I would like to take this opportunity of thanking all the members of the Group for their continued support, hard work and commitment to the overall aims and objectives of the Group. Similarly, I would like to thank all the parent organisations involved..

Huw G. Evans
Housing & Regulatory Services
Pembrokeshire County Council

Introduction

This is the sixth report of the Milford Haven Waterway Environmental Monitoring Steering Group and covers the period from 1st April 1997 – 31st March 1999. This is a longer time span than that of previous reports and is a reflection of researched work effort for the Sea Empress Environmental Evaluation Committee.

The Group's efforts however, are once again getting back into stride and several important parts of the Group's programme have now been completed, Executive Summaries being included in this document and progress continues with the outstanding projects.

Copies of all reports of work previously commissioned by the group are available in several public libraries in the County, including Haverfordwest Public Library.

The Group's work is underpinned by both financial and staff resource support from its constituent members, enabling it to take forward important research work.

Tenders are currently being sought for:-

(i) Sub-tidal eel grass beds survey (15)
(ii) Sediment hotspots (6)
(iii) Sediment sinks (8)

A Review of Nutrient Concentrations in the Milford Haven Waterway From October 1996 to September 1998

1.0 Introduction

This report examines concentrations of dissolved available inorganic nitrogen (DAIN) and phosphorus (DAIP) in samples collected in the Milford Haven Waterway between October 1996 and September 1998. The possible eutrophic status of the estuary is also considered.

Sample points within the Milford Haven estuary and the lower Western and Eastern Cleddau rivers are sampled routinely by the Environment Agency Wales, to collect data for a review in 2001 to assess the status of the estuary as a potential Sensitive Area under the European Union Urban Waste Water Treatment Directive (UWWTD). The data from these sites are reviewed annually, to assess the current status of the estuary and to identify any shortfalls in the data (Wyke, 1998; Bishop, 1999). In view of the *Sea Empress* incident of February 1996, it was felt that the data collected in 1996 might not be representative for this area. As a result data were only collected from these sites from July 1997. It was intended that twelve samples should be collected per year, with a bias of 2:1 towards summer sampling, as this is when algal blooms are most likely to occur.

An additional six sites in the Milford Haven Waterway are sampled monthly for chlorophyll-a and oil, but not for nutrients or algae, to provide water quality information for the Milford Haven Waterway Environmental Monitoring Steering Group.

The waterway receives nutrients from three qualifying Waste Water Treatment Plants (WWTP's) with a population equivalent (pe) greater than 10,000 pe (Milford Haven, Pembroke Dock and Haverfordwest) all of which receive secondary treatment (Map 1). There are also a number of smaller Waste Water Treatment Plants (WWTPs), combined sewer overflows (CSOs) and small discharges to land from septic tanks within the catchment. Other sources of nutrients to the estuary include agricultural run-off and loadings from fish farms in the estuary and the Eastern Cleddau.

2.0 Methodology

Data were reviewed from sample points between the lower Western and Eastern Cleddau rivers and the mouth of the Milford Haven estuary, from October 1996 to September 1998 (see Map 1).

Five determinands were reviewed in accordance with Department of the Environment (DoE) guidelines for the determination of Sensitive Areas, viz. areas which are, or are at risk of becoming, eutrophic:

i) Dissolved Available Inorganic Phosphorus (DAIP)
ii) Dissolved Available Inorganic Nitrogen (DAIN)
iii) Chlorophyll a
iv) Algal biomass
v) Dissolved oxygen

3.0 Results and Discussion

There were notable exceedances of the DoE criteria for Dissolved Available Inorganic Nitrogen (DAIN) and Dissolved Available Inorganic Phosphorus (DAIP) within the estuary during the review period (Tables 1 and 2). Therefore, hypernutrification exists within the estuary, which could lead to the formation of nuisance algal blooms under suitable conditions. Nutrient concentrations decreased from the freshwater stretches to the mouth of the estuary (Graph 1), a refection of several factors including dilution by seawater and possible nutrient utilisation by algae.

Table 1. Dissolved Available Inorganic Nitrogen (DAIN)* from October 1996 to September 1998

Site ref. (see Map 1)	Sample point no.	Mean (ug/l)	Min (ug/l)	Max (ug/l)	No.samples	No. exceedances of DoE Criterion**
1	32803	3940	1690	5500	20	N/A (freshwater)
2	32401	3030	570	3890	19	N/A (freshwater)
3	85117				0	
4	85119/39662	922	86	2557	21	20
5	85120				0	
6	39661/39671/ 39659	133	4	701	14	3
7	85122/39660	153	66	316	5	2
8	85124	344	21	728	16	11
9	85125				0	
10	39658	111	58	215	5	1
11	85126				0	
12	85127	176	6	459	16	8
13	39657	37	14	59	5	0
14	32783				0	
15	39654	40	9	78	5	0

*Total Oxidised Nitrogen (det.9110 for estuary (saline), det.116 for freshwater) plus Ammoniacal Nitrogen (det.206 for estuary (saline), det.111 for freshwater)

**DoE Upper limit for estuarine and coastal waters in winter: 168 ug DAIN/l in the presence of at least 6.2 ug/l DAIP

Table 2. Dissolved Available Inorganic Phosphorus (DAIP)* from October 1996 to September 1998

Site ref. (see Map 1)	Sample point no.	Mean (ug/l)	Min (ug/l)	Max (ug/l)	No.samples	No. exceedances of DoE Criterion
1	32803	35	10	110	43	1**
2	32401	20	<10	60	45	0**
3	85117				0	
4	85119/39662	25	10	44	21	See Table 1
5	85120				0	
6	39661/39671/ 39659	13	2	34	14	See Table 1
7	85122/39660	15	6	35	5	See Table 1
8	85124	16	8	24	16	See Table 1
9	85125				0	
10	39658	12	4	21	5	See Table 1
11	85126				0	
12	85127	11	0.25	20	16	See Table 1
13	39657	9	4	16	5	See Table 1
14	32783				0	
15	39654	11	4	23	5	See Table 1

*Orthophosphate (det.9130 for estuary (saline), det.180 for freshwater)

**DoE Upper Limit for Running Freshwaters: Annual Average of 100 ug/l

The main shortfall in the data for assessing the risk of eutrophication in the estuary is the availability of sufficient nutrient data for the winter months. Winter data are important for assessing candidate Sensitive Areas as it is only in the winter that nutrient concentrations can be assessed in the absence of significant utilisation by algae and higher plants. As a result of the strong bias towards summer sampling, therefore, the results reported here may greatly underestimate the extent of hypernutrification within the estuary.

The DoE criterion for chlorophyll-a was only exceeded at 2 of the 11 sites, each site on only 1 occasion during the review period (Table 3). Algal biomass was only found to have exceeded the DoE criterion at one site and on one occasion only during the review period (Table 4). Furthermore, there were no observed occurrences of dissolved oxygen supersaturation (>150%) during the review period. Therefore, there is little evidence from these data to demonstrate that the Milford Haven Waterway suffers from eutrophication.

Table 3. Chlorophyll a (determinand code 729) results from October 1996 to September 1998

Site ref. (see Map 1)	Sample point no.	Mean (ug/l)	Min (ug/l)	Max (ug/l)	No.samples	No. exceedances of DoE Criterion*
1	32803	6.80	1.56	42.70	19	0 (freshwater)
2	32401	5.83	1.74	28.30	19	0 (freshwater)
3	85117	2.71	1.03	5.13	19	0
4	85119/39662	4.9	1.79	32.09	21	1
5	85120	2.11	0.69	4.28	19	0
6	39661/39671/ 39659	7.6	0.18	5.25	14	0
7	85122/39660	2.3	0.89	5.76	26	0
8	85124	2.73	1.2	7.76	16	0
9	85125	2.16	0.74	5.22	19	0
10	39658	3.79	2.77	5.09	5	0
11	85126	2.11	0.71	4.91	19	0
12	85127	2.70	1.03	6.96	16	0
13	39657	2.45	1.74	4.21	5	0
14	32783	2.86	0.64	26.69	16	1
15	39654	1.98	0.98	2.99	5	0

*DoE Upper Limit: 10 ug/l for estuarine & coastal waters; 100 ug/l for running freshwaters

Table 4. Algal biomass (determinand code 948) results from October 1996 to September 1998

Site ref. (see Map 1)	Sample point no.	Mean (cells/ ml)	Min (cells/ml)	Max (cells/ml)	No.samples	No. exceedances of DoE Criterion*
1	32803				0	
2	32401				0	
3	85117				0	
4	85119/39662	52	0	160	21	0
5	85120				0	
6	39661/39671/ 39659	102	0	920	14	1
7	85122/39660	12	0	20	5	0
8	85124	67.50	0	220	16	0
9	85125				0	
10	39658	20	0	50	5	0
11	85126				0	
12	85127	82.50	0	240	16	0
13	39657	34	0	70	5	0
14	32783				0	
15	39654	52	0	140	5	0

*DoE Upper Limit: 500 cells/ml

However, blooms of the dinoflagellate *Alexandrium tamarense* have previously been recorded in the upper part of the Milford Haven Waterway, particularly in 1995. This species can produce Paralytic Shellfish Poisoning (PSP), but no effects on human health have been reported to date.

4.0 Conclusions

Although there was little evidence of eutrophication in the Milford Haven Waterway during the review period, there is strong evidence of hypernutrification in the estuary. The waterway could be considered, therefore, to be at risk of becoming eutrophic under certain conditions.

5.0 Recommendations

Further monitoring is required, with additional monitoring in the period December-February in each year, to collect sufficient data for an assessment of the Milford Haven estuary as a potential Sensitive Area under the EU Urban Waste Waters Treatment Directive. The final review of this data will be carried out in 2001, although the data should be reviewed annually to identify any shortfalls.

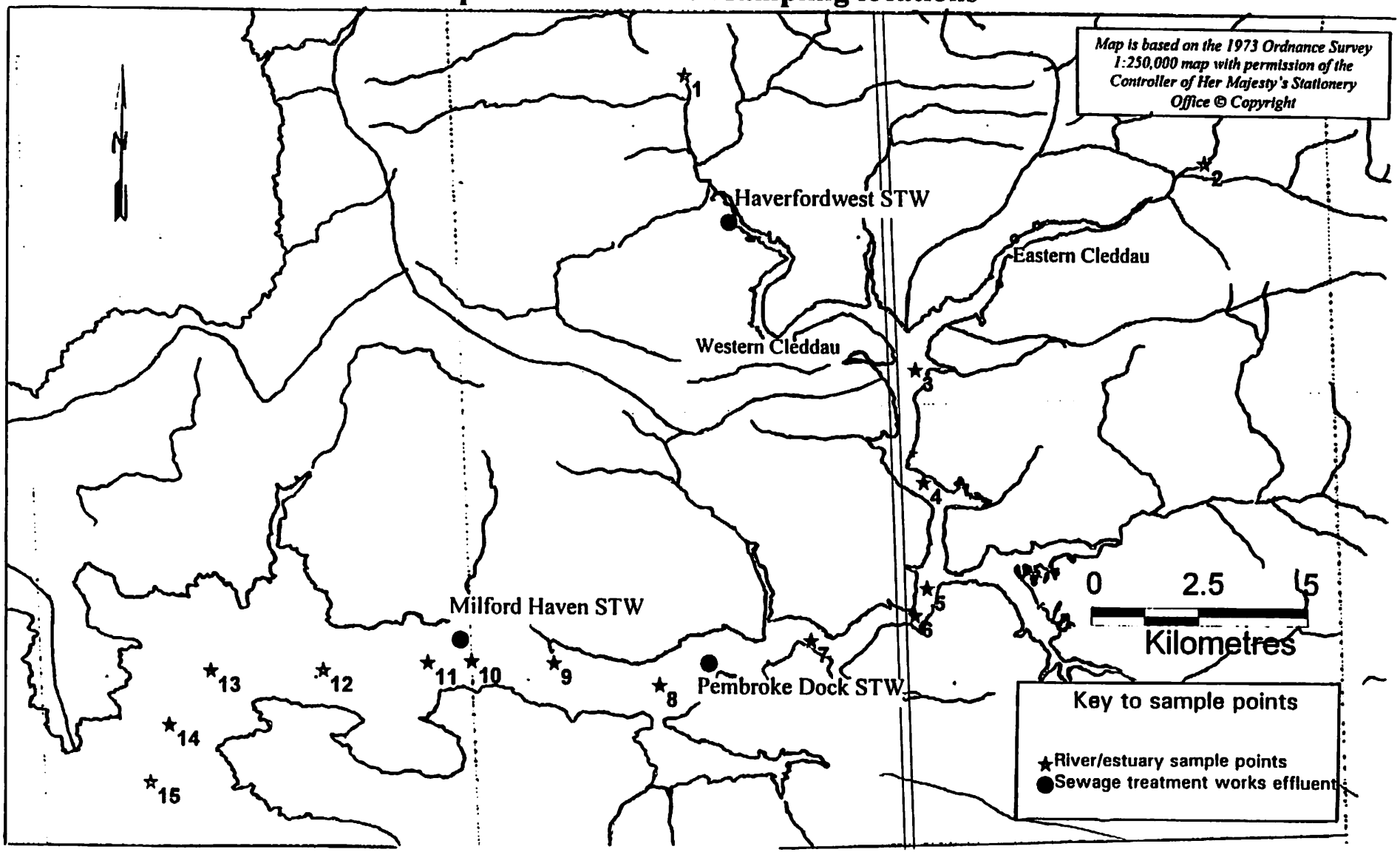
6.0 References

Wyke, S.J.D. (1998) *EC Urban Waste Water Treatment Directive: A review of the monitoring undertaken in the Milford Haven Estuary with regard to its candidature as a Sensitive Area, for the period October 1996 to September 1997.* TMW/98/23

Bishop, M.H.J. (1999) *EC Urban Waste Water Treatment Directive: A review of the monitoring undertaken in the Milford Haven Estuary with regard to its candidature as a Sensitive Area, for the period October 1997 to September 1998.* TMW/99/02

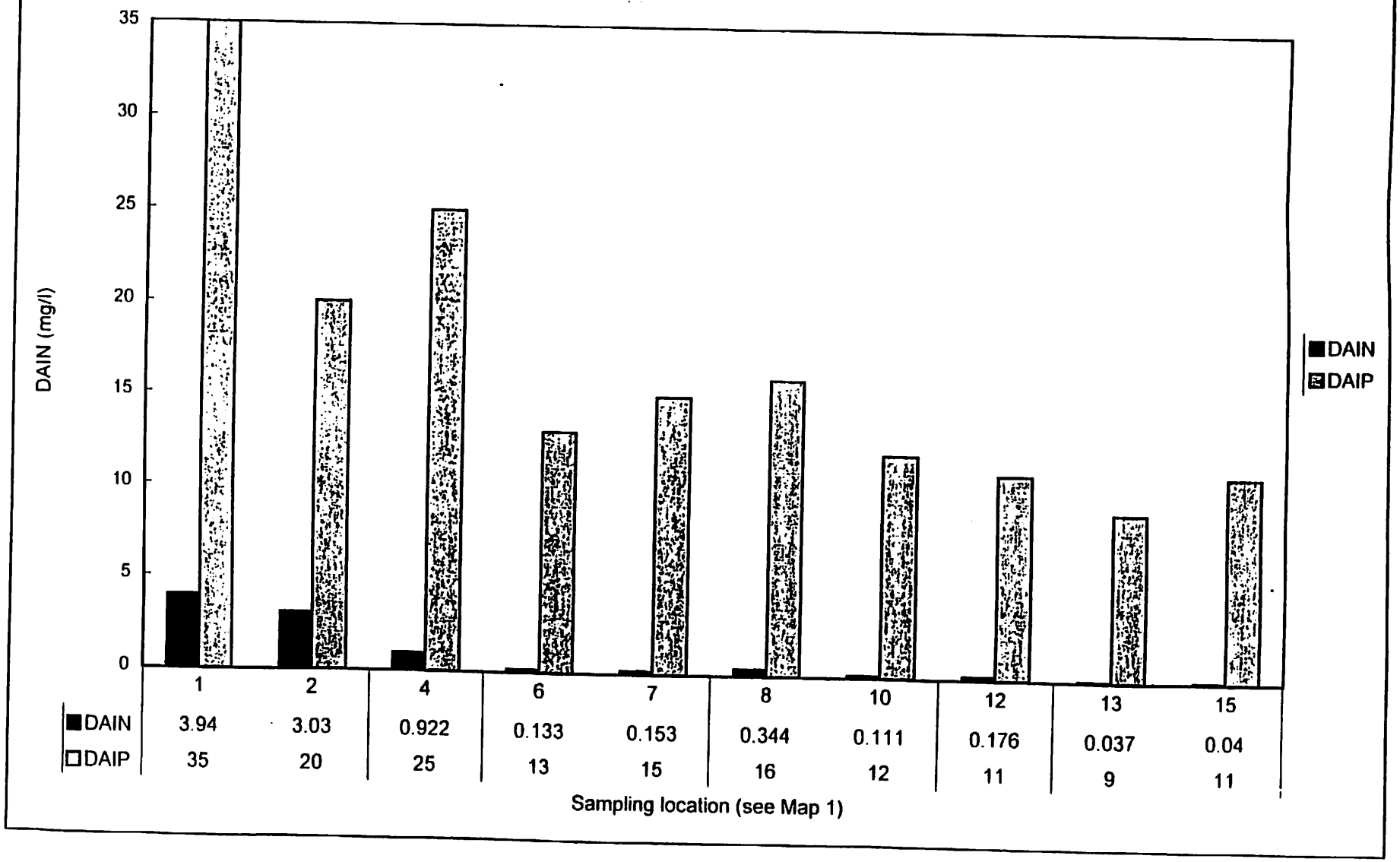
Contact: Paul Edwards
Environment Agency Wales, Penyfai Laboratories, Llanelli, Wales.
Date: January 1998
Tech Memo No: TMW/99/01

Map 1. Milford Haven sampling locations



Graph 1. Dissolved Available Inorganic Nitrogen and Phosphorus

Mean concentrations from October 1996 to September 1998



BATHING WATER QUALITY

Five sites within Milford Haven Waterway were tested for bathing water quality from May to September 1998 to determine the microbiological quality under the Bathing Water Directive 76/160/EEC. All five beaches are non identified. Samples were collected from each site on a weekly basis for 20 weeks by Environmental Health Staff of Pembrokeshire County Council, analysis carried out by Hyder Environmental Laboratories, Cross Hands.

Beaches

Beach	Location/Grid Ref	Sample Point No.
Dale	SM8130005700	39040
Sandy Haven	SM8570007300	39192
Gelliswick	SM8870005600	39037
West Angle	SM8520003300	39032
Watwick	SM8170004100	39634

Water Quality Results 1997/98

Beach	1997	1998
Dale	Mandatory	Mandatory
Sandy Haven	Mandatory	Guideline
Gelliswick	Fail	Mandatory
West Angle	Mandatory	Mandatory
Watwick	Not Tested	Guideline

Parameter Compliance Standards

Mandatory ("I" Compliance)

Faecal Coliform	No more than 2000 per 100 ml	95% compliance
Total Coliform	No more than 10,000 per 100 ml	95% compliance

Guideline ("G" Compliance)

Faecal Coliform	No more than 100 per 100 ml	80% compliance
Total Coliform	No more than 500 per 100 ml	80% compliance
Faecal Streptococci	No more than 100 per 100 ml	90% compliance

[1]

[1] T. Bennett, Pembrokeshire County Council

MILFORD HAVEN WATERWAY AND CLEDDAU ESTUARY: WILDFOWL AND WADER COUNTS 1997-98

Executive Summary

1. Introduction

The Cleddau Estuary and Milford Haven Waterway hold large numbers of waterfowl (wildfowl and waders) during the winter months, with numbers of shelduck, wigeon, teal, dunlin, and curlew reaching levels of "national importance" in most years.

Monthly counts of waterfowl are carried out throughout the autumn and winter as part of the national Wetland Bird Survey (WeBS). Since the winter of 1993-94 these counts have also been incorporated into a rolling programme of research and survey initiated by the MHWEMSG.

2. Methods

The dates of the counts are determined by WeBS to coincide with high spring tides. The estuary is divided into fifteen sectors and is counted by a team of observers. Counts normally take place within two hours either side of high tide when most species are assembled in high tide roosts. Sectors are counted by a combination of walking the shore and counting from fixed points depending on accessibility. Almost complete coverage of all sites was achieved between September 1997 and March 1998.

3. Results

During the peak period between November 1997 and February 1998 mean monthly totals of 4572 wildfowl and 8741 waders were present. The peak monthly count for wildfowl was 6878 in December, and for waders was 10,717 in January. The totals of the mid-winter maxima for each species were wildfowl 7644 individuals, and waders 12103 individuals. A minimum of 3,657 gulls (gull counts are not compulsory) made a minimum total of 23,404 birds using the estuary in midwinter.

Curlew (max.1338 in November and 1330 in February), shelduck (max.939 in January), wigeon (max. 3058 in December), Teal (max. 2594 in December) and dunlin (max 5318 in January) exceeded levels of national importance. Dunlin were the most numerous wader, with their second highest peak count since systematic recording of the whole estuary began in winter 1982-83.

Fifty-two species of waterfowl were recorded (excluding gulls), including eleven species of duck and twenty-three of waders. Divers, grebes, herons, cormorants and geese were also represented, together with mute swan, water rail and moorhen. Unusual species included red-necked, black-necked and Slavonian grebes.

4. Discussion

The mean midwinter monthly totals of waders and wildfowl were slightly lower than in 1996-97. However, curlew and teal numbers showed a slight increase over 1996-97.

Great crested grebes were again present in relatively large numbers (28 in January). As in previous years, Curlew were present in large numbers on autumn migration (2,200 in August).

Annie Poole
WeBS coordinator for Pembrokeshire
Pembrokeshire Ornithological Research Committee,Wildlife Trust West Wales.
5 June 1998

Milford Haven Waterway and Daugleddau Estuary
Annual Shelduck Counts - 1997

1. INTRODUCTION AND METHODS

The Daugleddau Estuary and Milford Haven Waterway hold nationally important numbers of shelducks during the winter months, and a small but significant summer population. The number of breeding shelducks has been assessed at various times during the 1960s and 1970s, and full surveys have been carried out on an annual basis since 1991. In 1993, the annual summer shelduck census was incorporated into the annual programme of monitoring drawn up by the MHWEMSG. The survey was repeated in 1997 by National Park staff using the NPA's small rigid-hulled inflatable boat.

As in previous years, fieldwork was carried out in June and in early August. The following information was collected:

- Location and numbers of pairs of shelducks, or single males apparently occupying territories;
- Location and numbers of pairs or single adults with broods;
- Location and numbers of other estuary birds;

All major pills, tributaries and embayments (except the Gann and Westfield Pill for which information was kindly supplied by local ornithologists) were surveyed from the boat on rising/high spring tides.

2 RESULTS

2.1. Shelducks

In June 1997, a total of 19 pairs with broods was located on the Western Cleddau (9), Eastern Cleddau (3), Carew River (3) and Pembroke River (4). A pair with 5 ducklings was seen off Popton Beach (Angle Bay) in late May; a pair with 9 ducklings was recorded in Westfield Pill and a pair with 11 ducklings was seen in the Gann.

By early August, an additional 3 pairs with broods had appeared: 1 on the Western Cleddau, 1 on Pembroke River and 1 on the Carew River. Thus 25 broods with a total of 186 ducklings were recorded in the estuary system in 1997, with an average of 7.44 ducklings per pair.

2.2. Other estuary birds.

During June 1997, relatively small numbers of waders, including 662 curlew and 174 oystercatchers remained on the estuary/waterway, in line with previous years' observations. Some 260 Canada geese and 119 mallard were also present, together with a small number of mute swans. By early August, the numbers of waders in the estuary system had risen dramatically to ca. 4000, of which 2,334 were curlew. Numbers of dunlin and oystercatcher were higher than in August 1996; numbers of other species such as redshanks, greenshanks and

common sandpipers were slightly down on the 1996 figures. A total of 305 Canada geese were recorded, indicating an upward trend in the Canada goose population.

The majority of the waders such as curlew and redshank recorded in August 1997 were almost certainly passage migrants.

3. DISCUSSION OF RESULTS

The data obtained in 1997 indicate that this was another very good year for breeding shelducks. and was on a par with 1996. Continuing low fox numbers (resulting in lower levels of predation) probably contributed to the relatively high number of broods and ducklings seen in 1997. The absence of broods in Cresswell River (where they have been regularly recorded in previous years), Angle Bay and Cosheston Pill could indicate disturbance and/or locally higher numbers of ground predators. The August data for other estuary birds once again underlines the importance of the Milford Haven Waterway and Daugleddau Estuary system for migrating birds, as well as for over-wintering birds.

4. FUTURE MONITORING

The annual summer shelduck census will be repeated in 1998, as part of the annual monitoring programme co-ordinated by the MHWEMSG.

A detailed account of the 1997 census is given in an unpublished report to the MHWEMSG and the Wildlife Trust (West Wales) Pembrokeshire Ornithological Research Committee.

Jane Hodges
Pembrokeshire Coast National Park Authority
June 1998.

Milford Haven Waterway and Daugleddau Estuary: Annual summer sheduck survey - 1998

1. Introduction and methods

The annual summer shelduck survey was carried out in 1998, using the same methods as those described in the summary of the 1997 survey. The survey was, once again, part of the MHWEMSG's programme of monitoring and it was undertaken by National Park staff. As in previous years, fieldwork was carried out in June and August, and the following information was collected: -

* Location and numbers of pairs or single males apparently occupying a territory;
* Location and numbers of adults with broods;
* Location and numbers of other estuary birds.

2. Results

2.1. Shelducks

A total of 22 broods were located during the boat surveys, comprising 179 ducklings. In addition to these broods, a further 3 broods comprising a total of 26 ducklings were located by local ornithologists in parts of the estuary system that were not covered by the boat survey. Thus the total number of broods recorded in 1998 was 25, with 205 ducklings seen. This compares with 25 broods and 186 ducklings recorded in 1997.

During June 1998, there were relatively small numbers of birds present on the estuary, including 80 curlews, 35 oystercatchers, 358 Canada geese and 83 mallard. By August, numbers of waders present had risen to 3000, 2393 of which were curlews. Other species present included redshank, greenshank, whimbrel, common sand piper and black-tailed godwit. A total of 377 Canada geese were also present, indicating a continued upward trend in Canada geese numbers.
These data reflect the pattern observed in previous years, and the importance of the estuary system for migrating water birds, especially curlews.

3. Discussion of results

The data obtained in 1998 indicated another good year for breeding shelducks which was on a par with 1997 and 1996. They suggest relatively low pressure on the population by ground predators such as foxes. The August data for other estuary birds once again underlined the importance of the Milford Haven Waterway and Daugleddau Estuary for migrating birds, (as well as for overwintering birds).

4. Future monitoring

The annual summer shelduck census will be repeated in 1999, as part of the annual MHWEMSG monitoring programme.

Jane Hodges
Pembrokeshire Coast National Park Authority

ROCKY SEABED SURVEY (PROJECT 13)

EXECUTIVE SUMMARY

This report describes a study to establish a series of monitoring stations on sublittoral hard substrate throughout Milford Haven, and to collect baseline data for these stations. The study was commissioned by the Milford Haven Waterway Environmental Monitoring Steering Group. The requirements of the study were to survey a range of rocky substrate sites throughout Milford Haven, and to establish permanent monitoring stations at these sites. The stations were to be surveyed using standard MNCR Phase II techniques, with quantitative descriptions of the epibenthos recorded within permanent quadrats or transects. The monitoring stations established were required to be easily re-locatable and sufficiently robust that they should survive a n-minimum of five years. In addition, a photographic and video record was to be compiled of each station. Thirteen possible sites were proposed, from which the survey and monitoring sites were to be selected. These sites ranged from Chapel Rocks at the mouth of the estuary, a wave-exposed, fully saline site where relatively clear water conditions prevail, to Landshipping Quay some 23km upstream, an extremely wave-sheltered site where low salinity and high turbidity conditions prevail. Out of these 13 possible sites, 9 were selected for survey and monitoring. These 9 sites were spread as evenly as practicable throughout the mouth, lower and middle reaches of the estuary.

The field work for this study was conducted during the summer of 1998, between the 16th of May and the 21st of July. A team of four, HSE qualified, diver/biologists was used for all diving operations. Diving operations were conducted from the 5.5m rigid-hulled inflatable (RIB) Starfish. The prime means of position fixing was a differential global positioning system (DGPS) using a local differential signal, supplied by Milford Haven Port Authority.

Due to the strong tidal streams prevailing within the Haven, diving operations were limited to relatively short periods of slack water during neap tides. All diving operations were conducted in accordance with HSE Diving Operations at Work Regulations 1997 Approved Code of Practice, Scientific and Archaeological Diving Projects (Health and Safety Commission) and Marine Biological Surveys Diving Regulations.

Sites were selected from the list of 13 potential sites to provide good spatial coverage within the study area, and to also cover as wide a range of hard substrate community types as possible (excluding the sublittoral fringe and kelp forest). Inevitably practical considerations, in particular weather conditions, also played a part. Exposed sites could not be worked during strong southerly or westerly winds, while upstream sites became more difficult (through reduced visibility) after periods of heavy rainfall. The 9 sites selected for survey and monitoring were: Chapel Rocks; Great Castle Head; Stack Rocks; Pennar Mouth; Dock Yard Bank; Pembroke Ferry; Cosheston Trot; Castle Rocks and Castle Reach. At Chapel Rocks, Pembroke Ferry and Cosheston Trot sites, distinct biological communities were recorded at different depth zones. Consequently two

separate stations (one deep, one shallow) were established at each of these sites. Thus in total 12 stations, each comprising four monitoring quadrats, were established.

The position of each station was recorded using DGPS. The location of each station was also marked, generally by anchoring a sub-surface buoy to the seabed. Where it was deemed necessary, additional markers were also established at set distances and directions from the station.

At each station, suitable positions for the four quantitative monitoring quadrats (each 0.5m2) were located. The precise location of each quadrat was permanently marked by fixing stainless steel bolts or ring bolts at, or close to, two of the quadrat corners. Where fissures in the rock could be exploited, the marking bolts were hammered into these and, where necessary, secured by filling the crevice with resin. Where fissures could not be used, holes were drilled using a pneumatic drill and the bolts secured in these, again using quick-setting resin. The position of each quadrat was mapped relative to the station marker and any other conspicuous features present.

An aluminium quadrat frame was positioned, in turn, over each quadrat, and the number of individuals or colonies of each species present was counted. Species that could not be identified underwater were collected and identified in the laboratory. Each quadrat was also photographed and videoed.

The general habitat in the vicinity of the station was also surveyed, and the abundances of conspicuous species recorded.

This report details the methods employed, and describes each site and station surveyed. Appendices of the report include:

* diagrams showing the quadrat positions in relation the station markers and general seabed features;
* details of the species recorded at each station and
* microphotographs of sponge samples collected
* photographs and edited video footage of the general habitat at each station and of each quadrat.

Recommendations

The report also includes a number of recommendations, these are summarised below.

1. **Site maintenance is conducted at no greater than two year intervals.**

Whist every effort has been made to ensure the monitoring stations will survive for five years, it is considered inevitable that there will be considerable deterioration and overgrowth within that time scale. It is therefore suggested that site maintenance is conducted at no greater than two year intervals. It is felt that the additional costs incurred for this increased servicing frequency will be offset by the savings incurred through conducting servicing before it becomes a major problem or station/quadrat

location and the increased confidence in comparisons made between data sets from successive periods.

2. Monitoring should be conducted at least biennially.

It s assumed that one major benefit from establishing the monitoring programme will be the provision of a benchmark 'condition' for each station, against which change, in particular change following a significant impact, may be measured. However, species assemblages may fluctuate naturally over time, particularly where fast growing, short-lived species dominate. Without a time-series data set of variation under natural conditions, it is difficult to distinguish between 'normal' change in species composition and that due to anthropogenic impacts. With a monitoring interval greater than two years, it is felt that the construction of a useable time-series dataset, and so parameters for change under normal conditions, will take an inordinately long time.

It may be desirable to prioritise monitoring effort, for example six of the sites could be selected for biennial monitoring, the remainder monitored on a more infrequent basis (e.g. every five or six years).

3. There should be a degree of continuity within the monitoring team.

Finally, it is strongly believed that the quality of monitoring data is greatly enhanced if there is a degree of continuity within the monitoring team. This does not necessarily mean that the same contractor should undertake the work, but that at least one team member should participate on successive monitoring exercises. No matter how detailed the descriptions are of site location, methodology and data work up, there will always be numerous small details held in surveyor's heads rather than described on paper. Ensuring these details remain constant helps to ensure comparisons of datasets are truly comparing 'like for like'. One practical way of ensuring this may be to have an employee of CCW (or other member of MHWEMSG) participate on part of each monitoring programme.

March 99 Marine Biological Services

CONTAMINANT SOURCING SURVEY (PROJECT 10)

Executive Summary

Hyder Consulting were commissioned by Milford Haven Waterway Environmental Monitoring Steering Group (MHWEMSG) to collect, collate and present data associated with the water quality of Milford Haven Waterway.

The main freshwater inputs to the Haven are the Eastern and Western Cleddau rivers, with a number of smaller rivers discharging directly into the waterway. Much of the catchment area is rural with heavy industry located on the shores of the Haven.

Data were collected from a number of sources including Environment Agency Wales, Dwr Cymru Welsh Water, Pembrokeshire County Council, CEFAS and research publications.

The types of data identified included water quality, biological, sediment and discharge data from the Haven and the Eastern and Western Cleddau Rivers. Information on Combined Sewer Overflows (CSOs), consented discharges, contaminated lands sites and landfill sites was also collected due to their potential impact on water quality.

A literature search was conducted to find data on other estuaries (industrial and rural) throughout the UK so that a comparison could be made with the water quality in the Haven. Although a large body of information was collected on up to 30 estuaries, in many cases it was not possible to make a direct comparison with the data from the Haven. This was due largely to the differing sampling methods and analytical techniques used by each organisation. However, where possible, comparisons were discussed.

The water quality data collected from the Haven and Eastern and Western Cleddau were compared with Environmental Quality Standards (EQSs). A large proportion of the determinands were not directly comparable with the EQSs. However, it showed that generally compliance was achieved.

An initial assessment was also made of the impact that run-off from roads could have on water quality in the Haven. The area of road directly adjacent to the Haven was estimated and standard concentrations for compounds typically found in run-off from roads were applied taking into account average rainfall figures.

The study has shown that there is a large body of information associated with Milford Haven Waterway, including the Eastern and Western Cleddau rivers. However, data coverage is not comprehensive or consistent, making spatial or temporal comparisons difficult. Even though a large number of organisations are interested in water quality issues relating to the Haven, only a relatively small number of these have substantial data holdings.

Heather Kitts
Hyder Consulting

HYDROCARBON CONCENTRATIONS IN THE MILFORD HAVEN WATERWAY FOLLOWING THE SEA EMPRESS OIL SPILL OF FEBRUARY 1996

The Group's 1995/96 report described the results of the initial monitoring of levels of total hydrocarbons (THC) in the water column following the *Sea Empress* oil spill. Results obtained in February and March 1996 peaked at between 1,220 and 5,380 µg/l (parts per billion) for sites in the lower Haven between Angle and Dale. By the beginning of April 1996 the THC concentration had reduced to between 5.7 and 14 µg/l at the same locations. The mean level in routine mid-channel points had fallen to 2.6 µg/l by May 1996, which were approaching the background levels that would be expected within the Waterway.

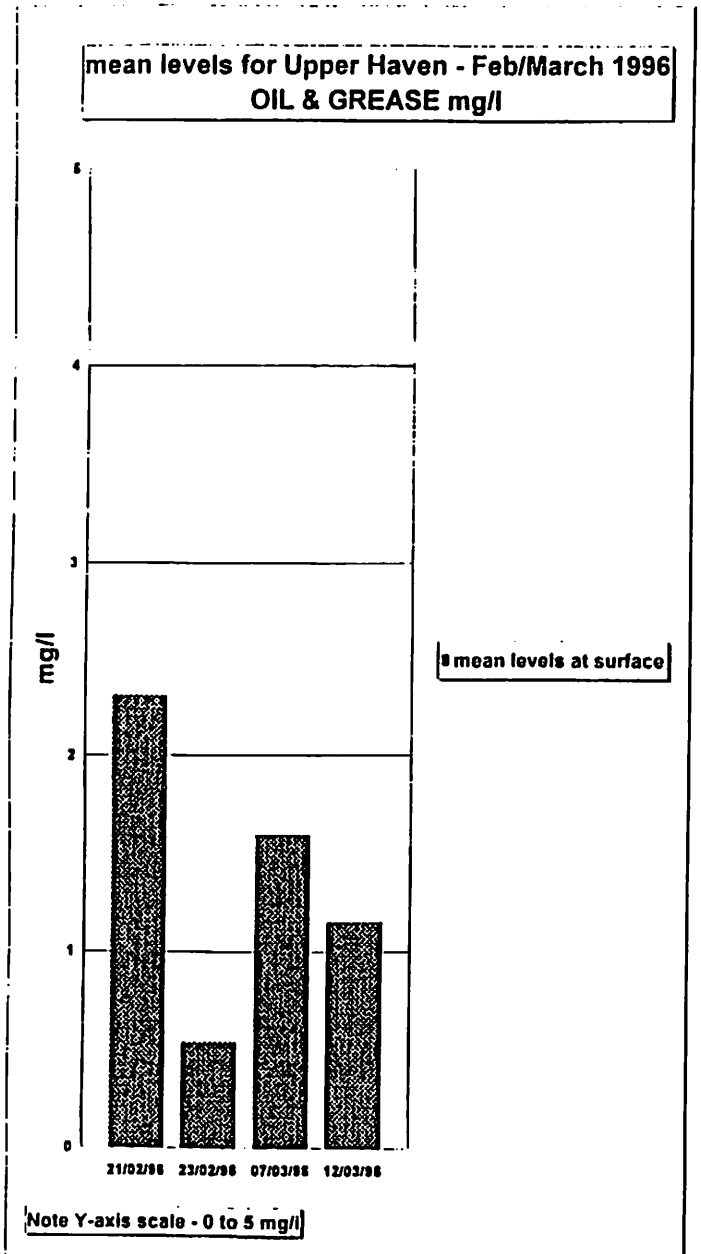
The mean THC levels measured throughout the Haven can be examined by looking at changes over time for the sample locations where post-spill survey work has been undertaken by the Group. These results have been summarised by grouping the sample locations into Upper (above the Cleddau Bridge), Middle (between the Cleddau Bridge and Texaco/Elf jetties) and lower (below the Texaco/Elf jetties) areas as shown in Figures 1 to 3 respectively. Each figure consists of two histograms, the left-hand one showing levels in mg/l (parts per million) from early monitoring using a less sensitive analytical technique which had a detection limit in the order of 300 µg/l. The right-hand histogram shows the results of the ongoing THC monitoring in µg/l using more sensitive, modern, analytical techniques.

The results for sample locations in the Upper Haven are shown in Figure 1. This area was the least heavily oiled within the Haven, and is influenced most by riverine inputs. The mean THC concentrations were generally within the expected background levels, but varied from a maximum of 14.5 µg/l in April 1996 to 0.9 µg/l in November 1996. The Middle Haven results (Figure 2) were less variable and lower than those in the Upper Haven, despite the monitoring points being in the area of the Waterway with the main concentration of population, sewage discharges and industrial effluent discharges. All the results in this area for mean THC levels since October 1996 have been less than 5 µg/l.

The mouth of the Haven had the highest levels measured in February and March 1996, with mean levels between approximately 0.7 and 4.6 µg/l. From August 1996 to June 1997 the mean results were back to the expected background levels for this area and were consistently low, being less than 2.5 µg/l. However, the mean result for July 1997 produced a significantly elevated mean result, of 50 µg/l TCH, as can be seen clearly from Figure 3. This was largely a result of 148 µg/l being detected at a sample point off Chapel Bay. Chapel Bay is a site that was not cleaned by the Joint Response Centre (JRC) and where sub-surface unweathered oil was recorded in the mid-shore in March 1997. This sample point may also be impacted by sub-surface oil still present in the mudflats at Angle Bay. In Angle Bay, despite extensive cleanup by the JRC, oil had migrated from original deposits on the upper shore, penetrated porous beach material and spread down the shore by the action of the tidal currents and associated dynamic movement of beach sediments.

This is indicative of the process, which can be expected to occur at other exposed sites where there are oil "sinks". Such areas would not be identified unless, as in the case of Angle Bay, they are close to a sample point or identified during detailed surveys of the seabed and shoreline. Although the mean THC concentrations, as measured in the water samples at mid-channel sample points, have returned to expected background values, the total impact of the *Sea Empress* oil spill on the Milford Haven Waterway can only be assessed after the results of the full range of SEEEC projects (outlined elsewhere in this Report) become known.

Author: Mr Mark Williams; Contact: Dr Shane Evans
Environment Agency Wales, Llys Afon, Hawthorn Rise, Haverfordwest, Wales
Date: July1998.



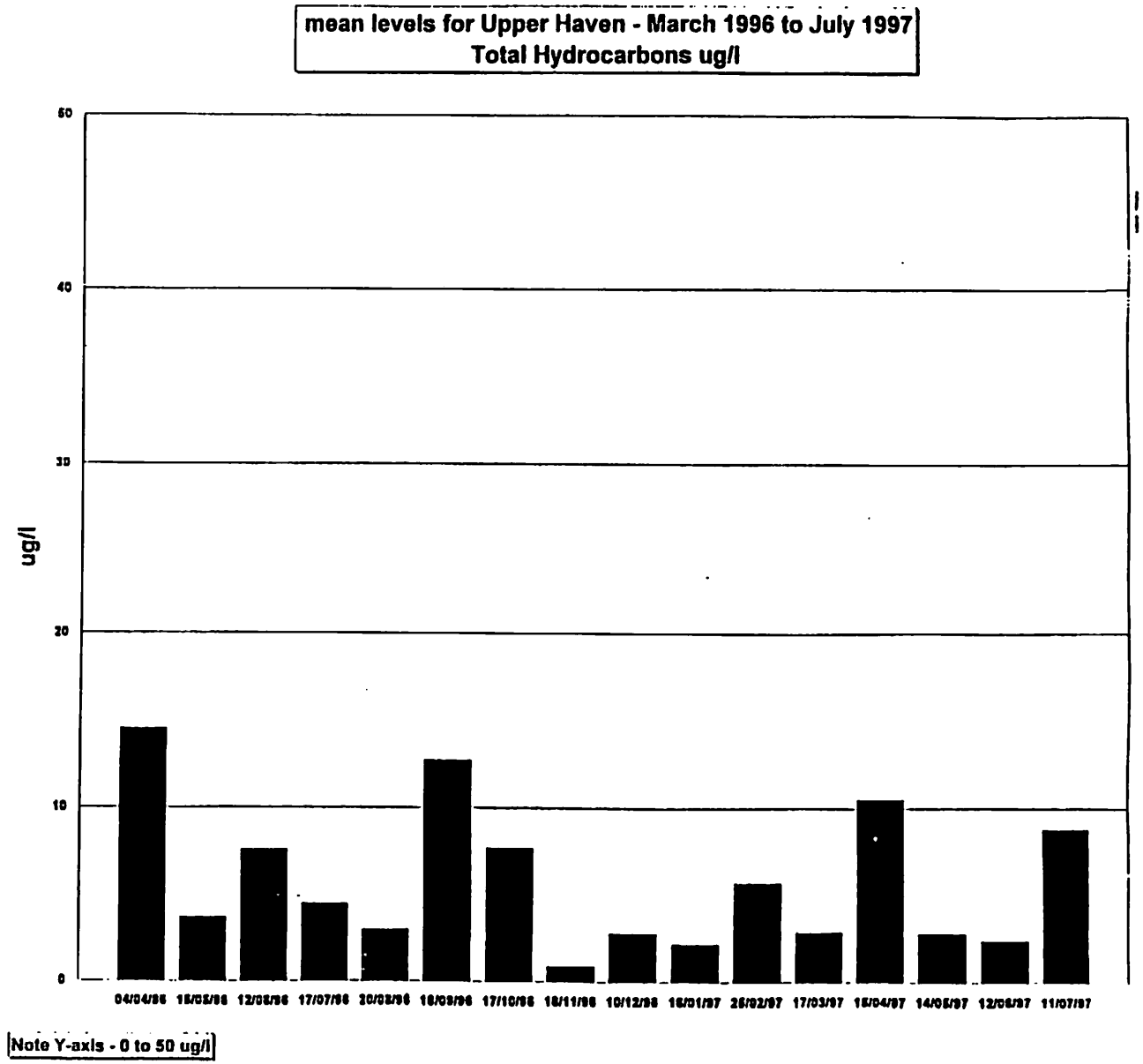


Fig. 1 - Upper Haven

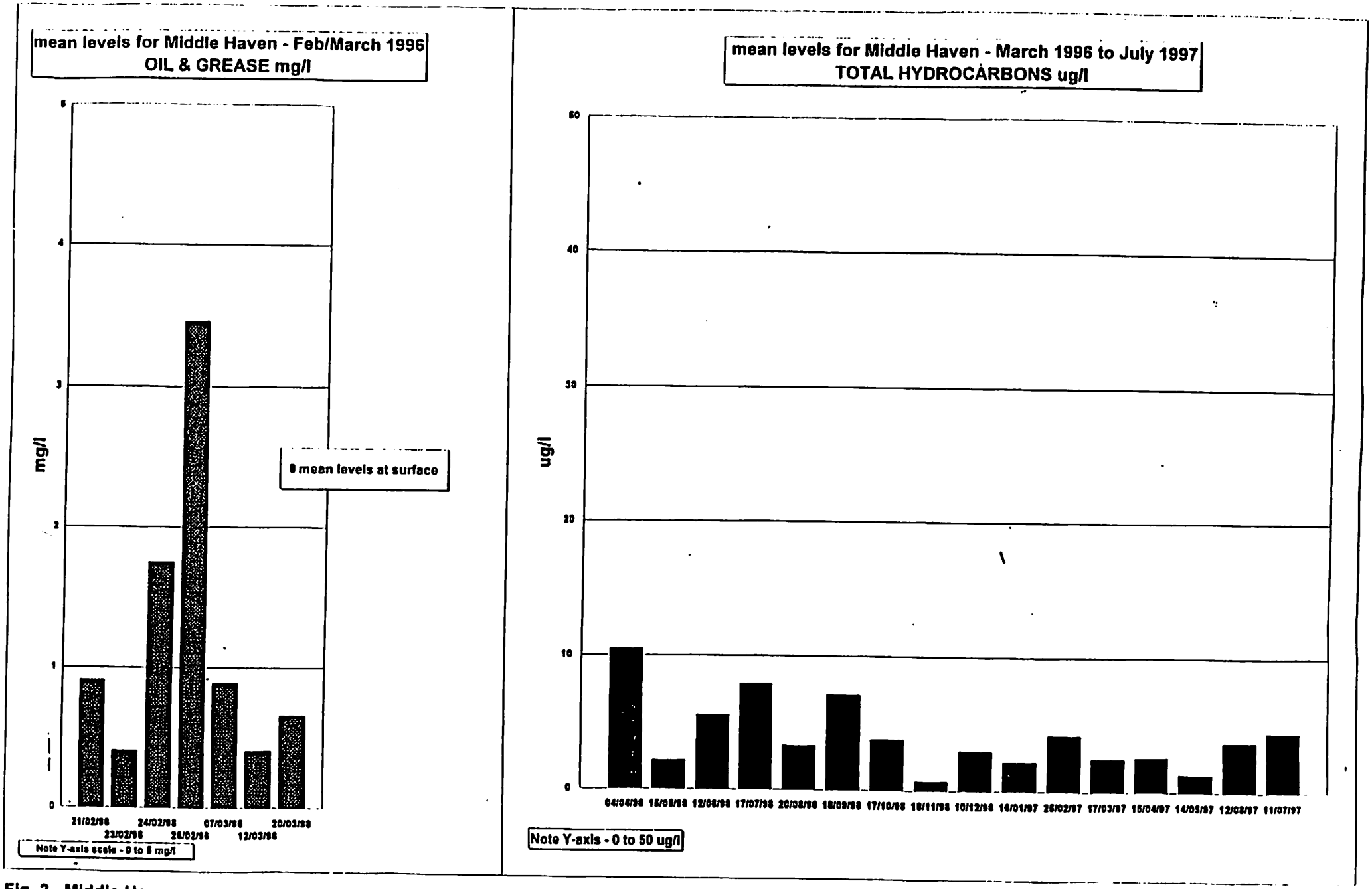
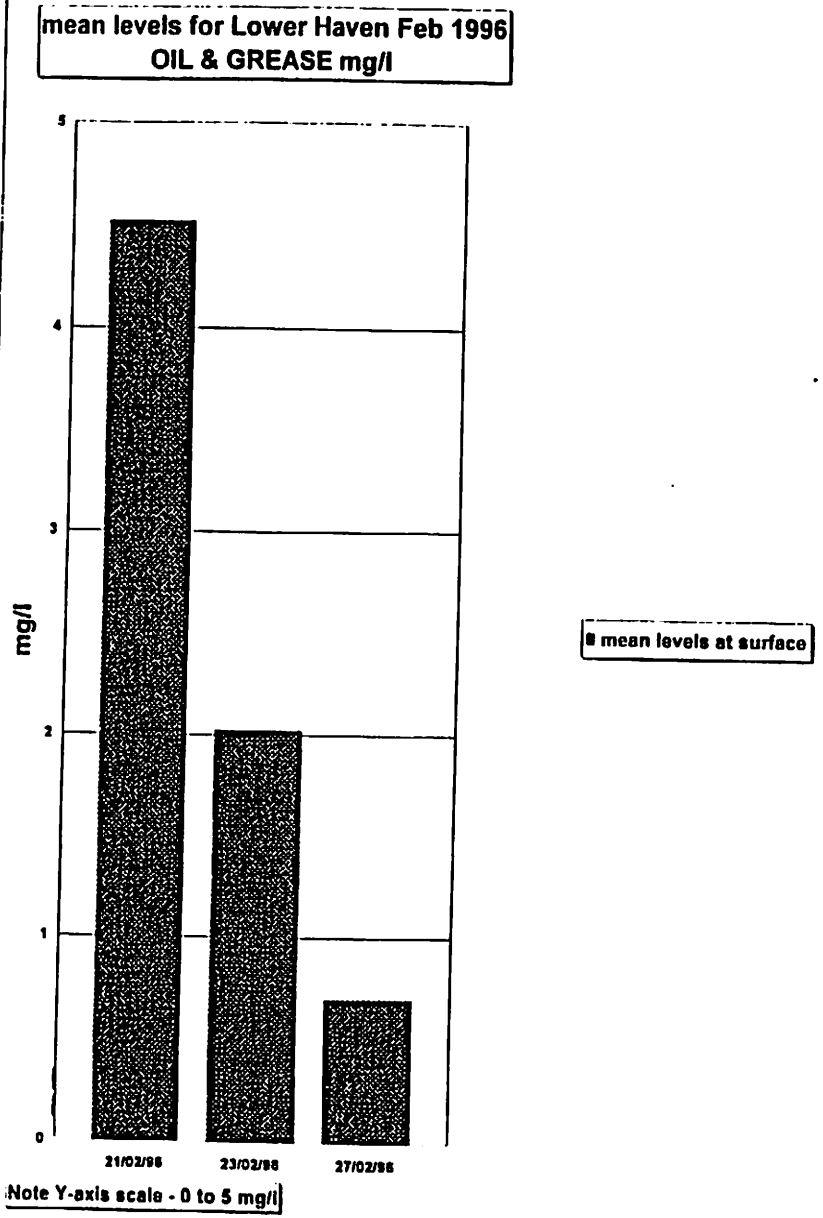


Fig. 2 - Middle Haven



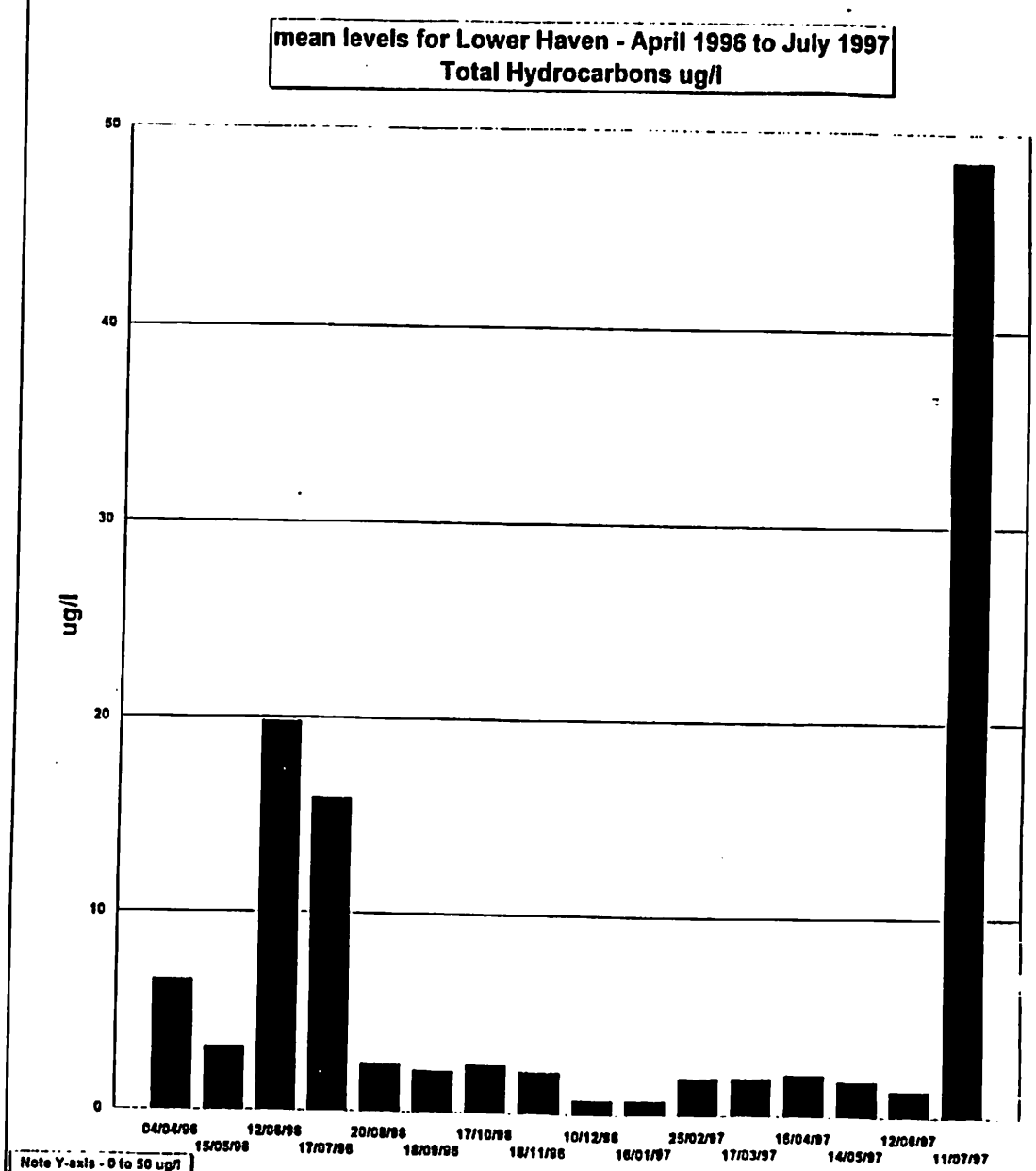


Fig. 3 - Lower Haven

FUTURE WORK PROGRAMME 1999 - 2000

Item No.		Projected Expenditure
6.	Sediment Hotspots	20,000
8.	Sediment Sinks	20,000
9.	(i) Wetland Bird Survey Wildlife Trust West Wales	1,000
	(ii) Annual Summer Shelduck Survey P.C.N.P.A.	
15.	Subtidal Eel Grass Survey)	20,000
	(Admin Support Eel-Grass survey)	2,000

PROJECTED TIMETABLE

MILFORD HAVEN WATERWAY ENVIRONMENTAL MONITORING STEERING GROUP
PROGRAMME OF WORK

	ACTIONS	Priority	Cost £000's	1996	1997	1998	1999	2000	2001
1	Database	1	10						
2	Administrative support	1	2						
3	Water quality monitoring	1	4.5						
4	Seabed sediments (i) Biology (5year repeat at selected sites) (ii) hydrocarbon analysis. Part of SEEEC Project (repeat of Groups 93 survey financed by EA/WO)	1 1							
5	Inter tidal sediments (i) Biology (5 year repeat at selected sites) (ii) metals analysis (iii) hydrocarbon analysis EA	1 1 1	6						
6	Sediment "Hotspots" (priorities to be decided from 4 & 5 above)	1	20						
7	Suspended sediment analysis (linked to 6 above)	2							
8	Sediment sinks (linked to 6 above, done with 7)	1	20						
9	Wildfowl and wader populations (PORC) (i) wintering (ii) breeding shelduck census (PCNPA)	1 1	1						
10	Contaminant sourcing (i) water quality input budgets (ii) linked to results of 6	1 1	8						
11	Use of Skomer as "reference"	1							
12	GIS system development	2							
13	Rocky shore and seabed monitoring (i) inter tidal survey (ii) seabed survey	1 1	60						
14	Salt marsh monitoring	2							
15	Eel grass beds (review following SEEEC report)	2							
16	Post-spill impact surveys (ad hoc)	1	3						
17	TBT contamination	2							
18	Bioaccumulation	2							
19	Dredging impacts on sediment transport (MAFF-MHWEMSG to assist)	2							
20	Recreation use survey	3							
21	Bait digging/changes in community structure (linked to results of 5(i) and 15)	2							
22	Intertidal terrestrial invertebrates	3							
23	Review of reports for decision for future research								
24	Review Group Terms of Retension	1		7			99		

KEY:

1996 Work

Possible/suggested period for work in future years given current priorities

GROUP REPRESENTATIVES

1.	Environment Agency Wales	Mark Williams/Rod Thomas
2.	Elf Oil UK Ltd }	
3.	Texaco }	John Everett
4.	Countryside Council for Wales	Blaise Bullimore
5.	Pembrokeshire County Council	Tom Bennett
6.	Pembrokeshire Coast National Park Authority	Jane Hodges
7.	Welsh Water/Dwr Cymru/Hyder	Hilary Ford
8.	Wildlife Trust West Wales	Alison Wheeler
9.	Milford Haven Port Authority	Captain Mark Andrews
10.	South Wales Sea Fisheries Committee	Phil Coates
11.	Welsh Office Environment Division	Dr Havard Prosser
12.	Pembrokeshire County Council – Chairman	Huw Evans

HE/AM