



National Evaluation Report on the Joint Assessment and Monitoring Programme of the Netherlands 2004

**R.W. Bovelander
V.T. Langenberg**

Report RIKZ/2006.002

February 2006

Summary

The Netherlands participates in the Joint Assessment and Monitoring Programme (JAMP) of the Oslo and Paris Commissions. In this framework it was agreed that all members or contracting parties should report on the national comments that accompany the data submissions to ICES database. This report presents the results and comments of the Dutch contribution to the JAMP programme 2004.

Wintertime nutrient concentrations of DIN (Dissolved Inorganic Nitrogen) and Ortho-phosphate were in agreement with earlier reported downward trends. Though both nutrients still exceed their respective MTR (Maximum Tolerable Risk concentration), the downward trend over the last 10 years seems more progressive for Ortho-phosphate than for DIN.

In general in water, all measured dissolved metal concentrations were smaller than the MTR levels. However, at brackish water location in river Meuse outlet and at a transitional water location in the Western Scheldt copper occasionally exceeded the MTR. Also zinc peaked at times in the Meuse outlet reaching concentrations above the MTR. The measured metal concentrations in sediment showed all to be below the MTR. However for the Western Scheldt As, Cd, Cr, Cu, Hg, Pb and Zn and for the Eastern Scheldt As, Cr, Hg, Ni, Pb and Zn occasionally reached concentrations above the VR.

The assessment of γ -HCH in water presented here confirmed the earlier findings reported in xxxx and showed a strong decreasing trend in concentrations up to levels well below the VR. Although the earlier reported decreasing trends (enkelvoud?) in TBT concentrations in water continued (not treated here) TBT concentrations in sediment still exceeded the MTR (set at 0.7 $\mu\text{g Sn/kg}$) by a factor of 24 to 100.

A general improvement in flounder health, in terms of lymphocystis, skin ulcers and liver tumours, was noted for the Wadden sea, Eastern Scheldt and coastal zone since the early nineties.

An overview is given of the quality assurance Programme of the Dutch Laboratories and details on detection limits, and participation in QUASIMEME and BEQUALM exercises.

Table of Contents

1	Introduction	9
2	Description of the monitoring programme	11
	2.1 The monitoring programme	11
	2.2 National areas	12
	2.3 Sampling and analyses	13
3	Compliance with the guidelines	17
4	Information on measurements	19
	4.1 Supporting parameters	19
	4.2 Nutrients in water	19
	4.2.1 The programme	19
	4.2.2 Trends in winter nutrient concentrations	19
	4.3 Metals	21
	4.3.1 Metals in Water	21
	4.3.2 Metals in Sediment	21
	4.3.3 Metals in Biota	22
	4.4 Organic contaminants	22
	4.4.1 Organic contaminants in Water	22
	4.4.2 Organic contaminants in Sediment	22
	4.4.3 Organic contaminants in Biota	23
	4.5 Biological effects	23
	4.5.1 Fish disease	23
5	Information on Quality Assurance	25
	5.1 Introduction	25
	5.2 Quality assurance at the National Institute for Coastal and Marine Management/RIKZ	25
	5.3 Sampling	25
	5.4 Analysis	25
	5.5 Detection limits	26
	5.5.1 Seawater and sediment	26
	5.5.2 Biota	27
	5.6 Intercalibration	28
6	Overall conclusions	29
7	Tables	31
8	References	44

Acknowledgement and requests for information

This “National Evaluation Report” has been compiled with the support of various officials at the National Institute for Coastal and Marine Management / RIKZ (part of the Ministry of Transport and Public Works, Directorate-General of Public Works and Water Management). Special thanks are due to the laboratories of the National Institute for Coastal and Marine Management at Middelburg and Haren and the laboratory of the National Institute for Fisheries Research (RIVO) in IJmuiden. The latter conducted and reported the fish diseases and analysed contaminants in biota. Thanks also to the designers of the Trend-y-tector (Internet website: www.trendytector.nl), used to perform trend analyses.

The data in this report has been retrieved from the database containing all Dutch statistical water monitoring information. This information is available on www.waterstat.nl (Dutch version).

Requests for information of any kind about this programme may be addressed to the Dutch delegations to the OSPAR MON, SIME and ASMO working groups,

or

to the Ministry of Transport, Public Works and Water Management
RIJKSWATERSTAAT
RIKZ
BasisInfoDesk
PO Box 20907
NL-2500 EX The Hague
The Netherlands
Phone +31-70 311 44 44
E-mail basisinfodesk@rikz.rws.minvenw.nl.

1 Introduction

Under the authority of the Oslo and Paris Commissions (OSPAR), the condition of sea areas covered by the OSPAR Convention is kept under continuous review. Monitoring is carried out to determine the effectiveness of the measures undertaken by OSPAR to improve this condition. The first meeting of SIME (in 1995) decided on the Joint Assessment and Monitoring Programme (JAMP), a combination of the national monitoring programmes of the contracting parties. The programme was further developed during the years that followed. The JAMP is the successor to the JMP, which had been in operation since 1978.

Since the structure of OSPAR (working) groups changed in 1995, monitoring and assessments have become the task of the Assessment and Monitoring Committee of OSPAR (ASMO). Monitoring is carried out by different Working Groups (e.g. SIME, MON and INPUT) under ASMO.

The JAMP programme covers environmental issues that will need to be addressed in an assessment. For a number of issues this involves monitoring. In 1996 the guidelines for the JAMP monitoring programme were updated and guidelines were developed for new issues. The first Quality Status Report on the new OSPAR structure, based on the results of both JMP and JAMP, was presented in July 2000.

The Dutch monitoring programme consists of biological and biological effect monitoring, the identification of spatial distribution and temporal trends, and chemical monitoring in water, biota, sediment and suspended matter.

Following further optimisation and modification of the programme in the course of 1995, chemical monitoring has been based since 1996 on two major objectives:

- Temporal trend monitoring (median-values are used)
- Compliance with national criteria (90-percentile values are used).

The Dutch part of the JAMP monitoring programme is part of this national chemical monitoring programme.

Each year contracting parties of the Oslo and Paris Commissions supply the results of their previous year's national JAMP monitoring programmes to the ICES database. It was agreed that members should provide "National Comments" : reports containing the information needed for the correct interpretation of the reported data. Standards for National Comments were discussed and updated at the SIME meeting held in February 1997.

This document contains the National Comments of the Netherlands for 2004, together with details of the monitoring programme itself and of compliance with the OSPAR guidelines and procedures, and a discussion of the monitoring results.

Chapter 2 describes the national JAMP monitoring programme and presents results for all contaminant/matrix combinations. Figure 1 presents a map of all locations in the different areas (see also chap. 6.2) where samples were collected in the Dutch part of the continental shelf. The corresponding locations can be found in table 1 with details of the programmed frequency of sampling. Table 2 presents the parameters measured in the relevant matrices and/or organisms. Finally, the locations used to calculate median and peak values for every area are presented in tables 16 and 17. The used locations and area codes are the codes used in the national databases in which the results of monitoring are stored.

Technical details of the national JAMP monitoring programme are given in the chapters following 'Overall conclusions' (chap. 6).

2 Description of the monitoring programme

2.1 The monitoring programme

A major evaluation of Dutch chemical monitoring was completed in 1995. As a result, a new national chemical monitoring programme came into operation in 1996 (refs. 12 and 13). The general aims of monitoring are trend detection, assessment of compliance with Dutch criteria combined with measuring of specific contaminants in (preferably) single matrices. Locations, frequency and parameters are presented in figure 1 and tables 1 and 2.

Risk limits are used in Dutch environmental policy and are the foundation of environmental quality standards. For surface waters and sediment (incl. suspended matter) two classes can be discriminated: 'streefwaarden' (comparable with Guidance values in EU systems; also considered as "Verwaarloosbaar Risico (VR)" or No Effect Levels; long term policy objectives), and 'MTR '-values (Maximaal Toelaatbaar Risico * Maximal Tolerable Risk concentrations; short term policy objectives) (table 18) (ref. 17).

Water

- Dissolved metal concentrations are more than quarterly measured at the river Rhine outlet at Rotterdam (NIEUWWTWG) and the Western Scheldt.
- The number of locations where nutrient concentrations are measured is 4 or 5 per area, with 4 measurements being taken in the winter period from December 1st to March 1st. This produces for nutrients yearly between 22 and 61 measurements per area, and allows the identification of trends. At locations used for phytoplankton sampling, the nutrients are as frequently sampled as the phytoplankton. At 2 locations in the Wadden Sea, samples for measuring nutrient concentrations are taken every month to gather information on incoming enrichments from the North Sea, an essential factor in the summer period.
- The number of measurements in the winter period varies from 4 to 16 times.
- The number of measurements in the winter period at the Noordwijk transect (from 2 to 70 km kilometers off coast) equals 15. With these data the concentration of dissolved nitrogen and organic phosphorus were calculated with linear regression at salinity 30 (fig 2 and 3).
- All supporting parameters including Oxygen are measured each time a station is visited. Chlorophyll-a is only measured together with samples for phytoplankton species composition.
- For pesticide concentrations in water, the number of locations is 1 in every area (except for the Western Scheldt and the New Waterway) and the frequency of sampling is generally 4 times a year.

SPM

- SPM is sampled as the major matrix for trend studies of metals and hydrophobic organic contaminants in five areas: the Western Scheldt, North Sea Coast, Western and Eastern Wadden Sea and the Ems-Dollard estuary. Because SPM monitoring is not yet part of the JAMP, these results are not reported to ICES and not presented in this document.

ABM

- In areas where SPM amounts are too low, hydrophobic organic contaminants are measured by way of active biological monitoring (ABM) using mussels (hanging out mussels for 6 weeks).

Sediment

In the sediment programme, samples are taken every 3 years from around 11 locations per area. In 2004 sediments in the Dutch Delta (western and Eastern Scheldt) were sampled at 22 locations (table 17).

Biota

- Measurements in biota cover:
 - Mussel and externally visible disease and liver nodules/tumours in Flounder in autumn
 - Mercury in Flounder muscle
 - Cadmium in Flounder liver
 - Metals in Mussel soft body
 - PCBs in Flounder liver and Mussel soft body
 - PAHs and pesticides in Mussels soft body

Flounder is sampled in the coastal zone and estuaries and Mussels in the Western Scheldt, the Voordelta and the Ems-Dollard.

2.2 National areas

Dutch marine and brackish waters are divided into 11 areas (abbreviation used in tables is given in brackets):

1. Western Scheldt: from the Belgium border to the North Sea (WESTSDE).
2. Eastern Scheldt: behind the storm surge barrier (OOSTSDE).
3. Lake Grevelingen
4. Veerse Meer (a saltwater lake)
5. Voordelta: defined as the area 0 - 20 km off the coast at the mouth of the Scheldt/Rhine/Meuse delta (VOORDTA).
6. North Sea Coast: the area 0 - 20 km off the North Sea and Wadden Sea Coast (KUSTZNE).
7. Southern North Sea: Dutch part of the North Sea continental shelf south of the Frisian Front (ZUIDLKNZE).
8. Central North Sea: Dutch part of the North Sea continental shelf from the Frisian Front to the Dogger Bank (CENTLNZE).
9. Western Wadden Sea: from Marsdiep to half way up Terschelling and the Frisian Coast (WADDZWT).
10. Eastern Wadden Sea: between Western Wadden Sea and Ems-Dollard estuary (WADDZOT).
11. Ems-Dollard estuary: Dutch part of the Ems-Dollard down to the North Sea (EEMSDL).

The locations used to calculate median (M) and peak (P) values for each area are presented in table 13. Lake Grevelingen and Veerse Meer are not part of the OSPAR convention area and not presented in this document.

2.3 Sampling and analyses

The sampling departments of the regional divisions of the Directorate-General for Public works and Water Management carry out sampling by using standard sampling guidelines (RWSVs). RIKZ, RIZA and RIVO laboratories carried out analyses. There were no major changes in the procedures used. Methods for water, sediment and biota are described in the following documents:

List of analytical methods used for sediment samples contaminants with matching codes, 6th edition (April 2003), RIKZ-MI/2003.007X (ref.10).

List of analytical methods used for seawater contaminants with matching codes, 11th edition (July 2003), RIKZ-MI/2003.013X (ref 9).

List of analytical methods used for biota samples contaminants with matching codes, 3rd edition (April 2002), RIKZ-IT/2002.116X (ref 11).

Figure 1. Sampling locations 2004 (see table 1 and 17 for location numbers).

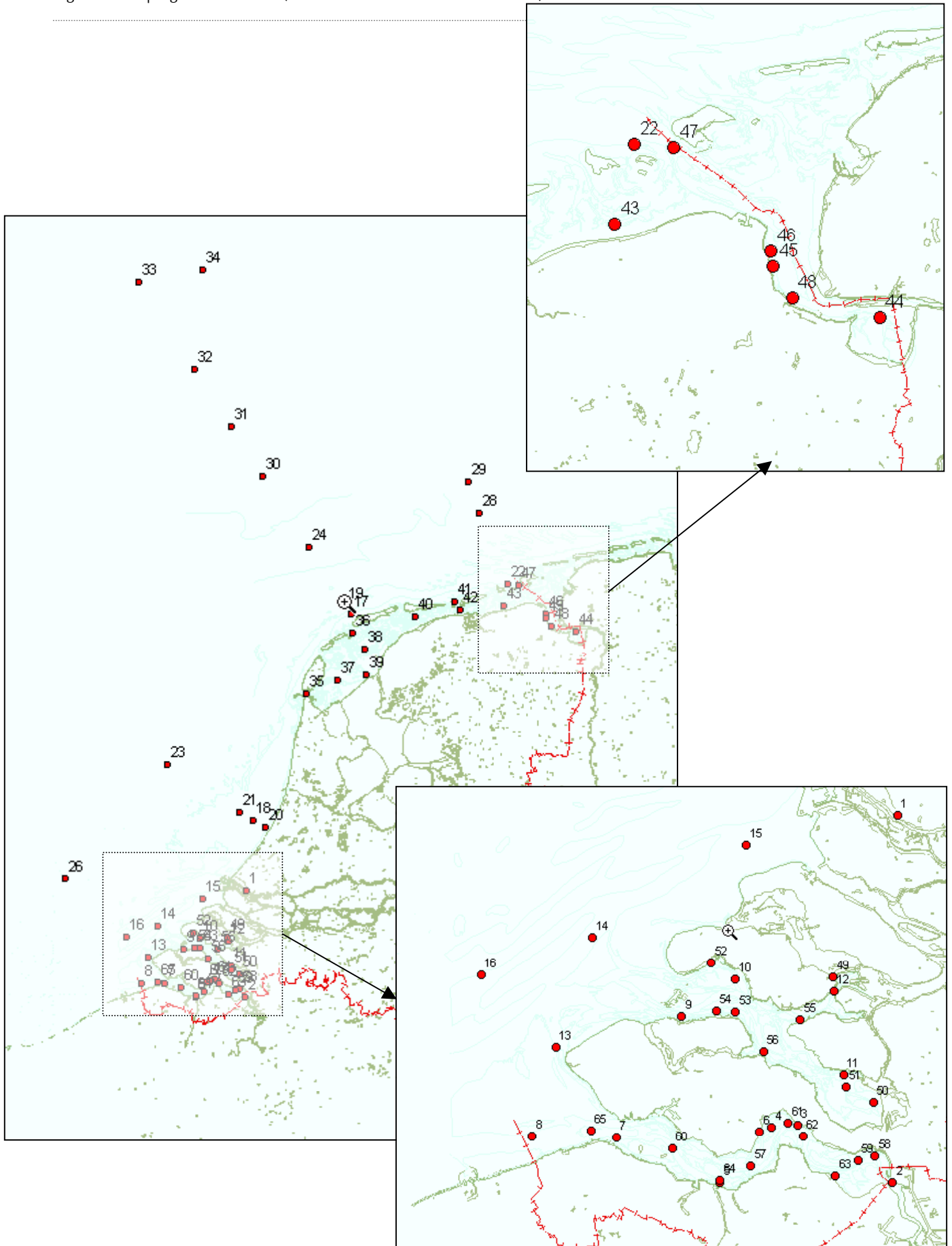


Table 1. Sampling frequencies for the areas covered by the Dutch chemical monitoring programme. The locations are presented in Figure 1.

No	ICES CODE	AREA LOCATIONS	water	water	water	sediment	biota	water	sediment	biota	biota
			Supporting parameters	Nutrients	Metals			Organic contaminants			Biological effects
New Waterway											
1	54.0.1	MAASSS	26	26	26	-	-	13	-	-	-
Western Scheldt											
2	21.1.1	SCHAARVODDL	26	26	26	-	-	13	-	-	-
3	21.1.2	HANSWGL	19	19	13	-	-	13	-	-	-
4	21.1.4	MIDDGBWMLPT	-	-	-	-	1	-	-	1	-
5	22.2.1	TERNZBI20	4	4	13	-	-	13	-	-	-
6	22.2.2	HOEDKKB14	13	-	-	-	1	-	-	1	-
7	22.3.1	VLISSGBISSVH	19	19	13	-	-	13	-	-	-
8	22.3.4	WIELGN	6	4	-	-	-	4	-	-	-
Eastern Scheldt											
9	23.0.2	WISSKKE	20	20	-	-	-	4	-	-	1
10	23.0.3	HAMMOT	20	20	-	-	-	-	-	-	-
11	23.0.6	LODSGT	20	20	-	-	-	4	-	-	-
12	23.0.9	ZIJPE	20	20	-	-	-	4	-	-	-
Voordelta											
13	21.1.5	WALCRN2	12	12	-	-	-	4	-	-	-
14	21.1.6	SCHOUWN10	12	4	-	-	-	4	-	-	-
15	21.1.7	GOERE6	12	12	-	-	-	4	-	-	-
16	21.3.3	WALCRN20	12	12	-	-	-	-	-	-	-
North Sea Coast											
17	21.1.12	TERSLG4	19	19	-	-	-	4	-	-	-
18	21.2.11	NOORDWK10	31	31	-	-	-	-	-	-	-
19	21.2.13	TERSLG10	18	18	-	-	-	-	-	-	-
20	21.2.2	NOORDWK2	19	19	4	-	-	12	-	-	1
21	21.3.2	NOORDWK20	19	19	-	-	-	4	-	-	-
22	21.4.1	ROTTMPT3	7	7	-	-	-	-	-	-	-
Southern North Sea											
23	21.5.10	NOORDWK70	19	19	-	-	-	12	-	-	-
24	21.5.11	TERSLG50	6	4	-	-	-	4	-	-	-
25	21.5.12	TERSLNWT40	-	-	-	-	-	-	-	-	-
26	21.5.8	WALCRN70	12	12	-	-	-	4	-	-	-
27	21.6.6	IJMDWT80	-	-	-	-	-	-	-	-	-
Central North Sea											
28	21.4.4	ROTTMPT50	7	7	-	-	-	-	-	-	-
29	21.5.4	ROTTMPT70	3	3	-	-	-	-	-	-	-
30	21.6.1	TERSLG100	18	18	-	-	-	-	-	-	-
31	21.6.2	TERSLG135	18	18	-	-	-	4	-	-	-
32	21.6.3	TERSLG175	18	18	-	-	-	-	-	-	-
33	21.6.4	TERSLG235	18	18	-	-	-	-	-	-	-
34	21.6.7	DOGBK	-	-	-	-	-	-	-	-	-
western Wadden Sea											
35	24.0.1	MARSDND	21	21	-	-	-	4	-	-	-
36	24.0.2	VLIESM	12	12	-	-	-	-	-	-	-
37	24.0.3	DOOVWBT/WIERBASDP	12	12	-	-	1	12	-	1	1
38	24.0.4	BLAUWSOT	12	4	-	-	-	4	-	-	-
39	24.0.5	DOOVBOT	6	4	-	-	-	4	-	-	-
eastern Wadden Sea											
40	24.1.1	DANTZGT	21	21	-	-	-	4	-	-	-
41	24.1.2	ZOUTKPLZGT	12	12	-	-	-	-	-	-	-
42	24.1.3	ZOUTKPLG	12	12	-	-	-	4	-	-	-
43	24.1.4	ZUIDOLWOT	21	21	-	-	-	4	-	-	-
Ems-Dollard estuary											
44	25.1.1	GROOTGND	21	21	-	-	-	12	-	-	-
45	25.1.3	PAAPGTGRDPT	-	-	-	-	1	-	-	1	-
46	25.2.1	BOCHTVWTND	6	4	-	-	-	4	-	-	-
47	25.2.2	HUIBGOT	21	21	-	-	-	4	-	-	-
48	25.2.3	BOCHTVWTM	6	4	-	-	1	4	-	1	-

1* In 2004 sediment in these areas were sampled on 22 locations. The locations are listed in table 17 including geographical information.

Table 2. Parameters measured in the different matrices of marine waters under the Dutch JAMP in 2004.

group	parameter	description	water	sediment	dab	biota flounder	mussel
Supporting parameters	SALNTT	salinity	+				
	SPM	suspended matter	+				
	T	temperature	+				
	O2	oxygen	+				
	ChlFa	chlorophyll-a	+				
	OC	organic carbon		+			
	lutum	fraction <2 µm		+			
	POC	purgeable organic carbon	+				
TOC	total organic carbon	+					
Nutrients	N	total Nitrogen	+				
	P	total Phosphorous	+				
	NH4	ammonium	+				
	NO2	nitrite	+				
	NO3	nitrate	+				
	o-PO4	ortho-phosphate	+				
	SiO2	silicate	+				
Metals	Al	aluminium		+			
	As	arsenic		+			+
	Cd	cadmium	+ ¹⁾	+		+	+
	Cr	chromium		+			+
	Cu	copper	+	+			+
	Hg	mercury		+		+	+
	Ni	nickel	+ ¹⁾	+			+
	Pb	lead	+ ¹⁾	+			+
Zn	zinc	+ ¹⁾	+			+	
Organic contaminants	α-HCH	alpha-HCH	+				+
	β-HCH	beta-HCH	+				+
	γ-HCH	gamma-HCH (lindane)	+				+
	4.4'-DDD	p,p'-DDD					+
	4.4'-DDE	p,p'-DDE					+
	4.4'-DDT	p,p'-DDT					+
	Atr	atrazine	+				
	Sim	simazine	+				
	DIURN	diuron	+				
	TBySn	tributyltin-compounds		+			
	HCB	hexachlorobenzene		+		+	+
	PCB...	PCB-congener		+		+	+
	s_PCB7	sum 7 Ballschmiter PCBs		+		+	+
	DIELDRN	dieldrin					+
	QCB	pentachlorobenzene					+
	Hepo	b-heptachloro-epoxide					+
PCTA	pentachlorothioanisole					+	
PAH	polycyclic aromatic hydrocarbon (16EPA)		+		+	+	
s_PAH6	sum 6 Borneff PAHs		+		+	+	
Biological effects	-	fish diseases				+	

+ ¹⁾ only brakish water

3 Compliance with the guidelines

The guidelines were revised and guidelines for new monitoring issues were produced at ADHOC meetings in 1995 and 1996. A proportion of these guidelines were then adopted by ASMO in 1997. This work is now finished and a new Manual was completed by the OSPAR secretariat in 1998.

Biota sampling in the Netherlands is performed in accordance with the guidelines (A11/94-E of the Manual, Oslo and Paris Commissions, 1990), except that Mussels are directly preserved and not allowed to discharge pseudo-faeces. This process is not considered to have a significant influence on the concentrations. Length-stratified sampling is used for Flounder. Dab samples are pooled over a transect and Mussels are pooled for each length class. The analytical methods are described by Van Zeijl (2002/ref.11).

Monitoring of seawater is done in accordance with the guidelines (A12/90-E of the Manual, Oslo and Paris Commissions, 1990). The analytical methods were described by Bovelandt (RIKZ-MI/-2003.013X, 2003 / ref. 9).

The measurement of biological effects was part of the NSTF (North Sea Task Force) programme, which was incorporated into the JAMP monitoring programme. The analytical methods were described by Van Zeijl (RIKZ-IT/2002.116X, 2002 / ref. 11).

4 Information on measurements

4.1 Supporting parameters

Many of the OSPAR guidelines describe requirements for supporting parameters. For two of these (Oxygen and Chlorophyll-a), a specific guideline is available.

These parameters are measured each time a station in the Dutch national programme is visited, except for Chlorophyll-a which is measured only when phytoplankton samples are taken.

Table 1 lists the frequency of measurement of supporting parameters. The locations are grouped into geographical areas and the results (median and peak values) for each of these are presented in table 5.

4.2 Nutrients in water

4.2.1 The programme

General concentrations of nutrients like Nitrogen, Phosphorus and Organic Carbon are measured every time the stations are visited. The median and peak values (shown in table 6) are taken over the whole of 2004. The inorganic nutrient concentrations measured during the winter period (December 1st to March 1st) are used for trend detection.

The nutrient data in the winter period are presented in table 7. The frequency of sampling for phytoplankton is the same for nutrients (see tables 1 and 5: i.e. every month during the winter and every two weeks during the summer).

4.2.2 Trends in winter nutrient concentrations

In Dutch marine waters with salinity gradients "nutrient-salinity-plots" are produced by plotting each year's winter nutrient concentrations versus the measured salinity values.

This procedure, often called mixing diagrams, was adopted by NUT in 1989. In winter, when algae activity is lowest, nutrients show more or less conservative behaviour and a clear linear relationship with salinity: i.e. increase in concentration with decreasing distance from the coast (refs. 1 to 3). The slope of the regression line in the mixing diagram is an indication of the level of nutrient inputs from land/coast during a particular year or years. For instance, a steep slope is an indication of high levels of nutrient inputs when compared with (salinity specific) reference (= background) concentrations.

In order to "compensate" for differences in salinity at the various locations from one year to another (due to differences in yearly river discharges), nutrient concentrations are "normalised" for salinity by calculating the winter nutrient concentrations at a given salinity (30) from the mixing diagram for a particular year. Trends in the yearly winter nutrient concentrations at a given salinity can be assessed accordingly (Figs. 2 and 3).

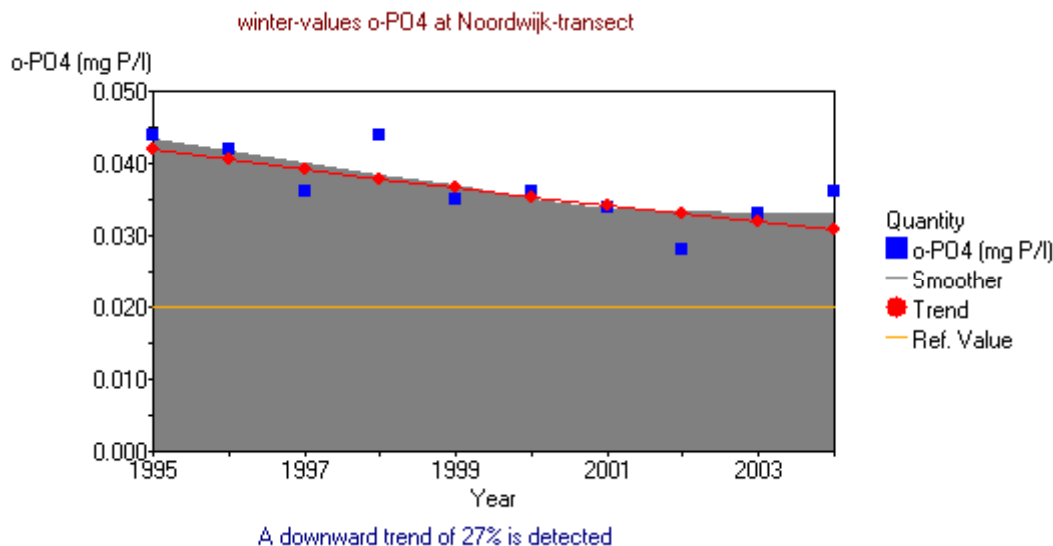


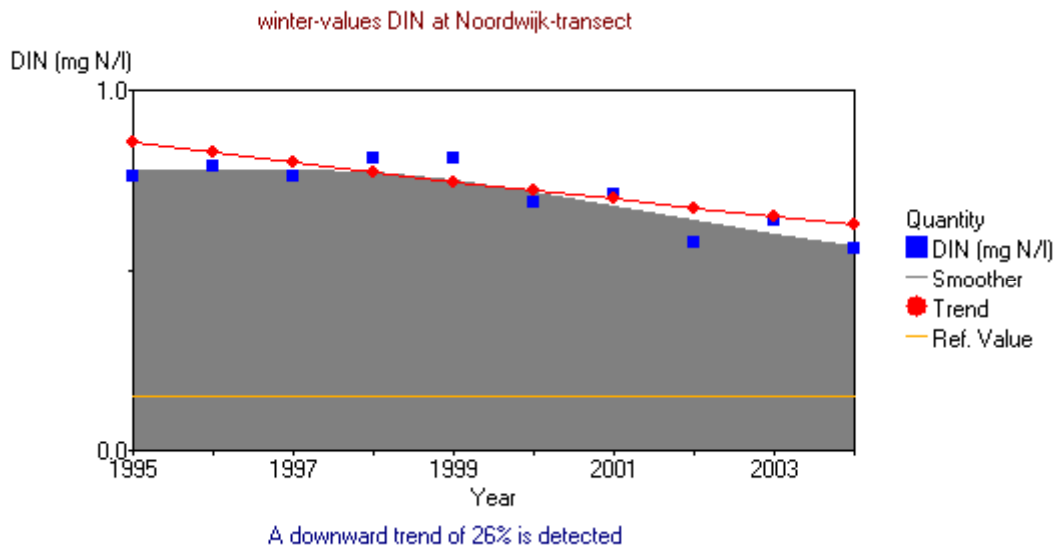
Fig. 2. Winter concentrations of log transformed standardized ortho-phosphate on the Noordwijk transect at salinity 30. Winter period is from December 1st year(n-1) to March 1st year(n).

- For fig.2 and fig 3: The trend was estimated by a suite of trend detection methods called Trend-Y-tector. This suite of methods for detecting and estimating trends was developed in co-operation with members of the statistical working group of the International Council for the Exploration of the Sea (ICES) and is available on the Internet (www.trendyector.nl).

Until 2004 there was a downward trend (Mann-Kendall, 1-sided, 5% significance) of 27%. This trend was more evident in a narrow strip (1-4 km) along the Dutch coast (refs. 4 and 5). The wintertime background value of the ortho-phosphate concentration is 0.02 mg P/l. The wintertime concentration of ortho-phosphate on the Noordwijk transect is slightly declining towards this objective.

In the case of total dissolved inorganic Nitrogen, a downward trend of 26 % in the elevated concentrations has been observed over the last 10 years (Fig. 3) (Mann-Kendall, 1-sided, 5% significance). Despite the decrease, concentrations still exceed the reference value (= background value of 0.15 mg N/l) by a factor of 3-4. This is due to the additional N-inputs over the last two decades (refs. 6 and 14).

Fig. 3. Winter concentrations of log-transformed standardized dissolved inorganic Nitrogen on the Noordwijk transect at salinity 30. Winter period is from December 1st year(n-1) to March 1st year(n).



4.3 Metals

Metals were measured in three matrices:

- 1) Water (dissolved)
- 2) Sediments (<63 μm)
- 3) Biota (fish and mussel).

Since the optimisation of the national programme in 1996, total metal concentrations in seawater have no longer been measured.

Measurement of dissolved Mercury at marine locations ended in 1998 and of dissolved Chromium and Arsenic in 2000. In 2003 only Cadmium, Copper, Nickel, Lead and Zinc were monitored in transitional and coastal waters.

The Dutch national programme also includes concentrations of metals in SPM but the data are not reported here since this is not yet part of the JAMP monitoring programme.

4.3.1 Metals in Water

Concentrations of dissolved metals are presented in table 8.

At the brackish water location (NIEUWWTWG) and at the transitional water in the Western Scheldt the peak values of Copper (resp. 2.9 and 1.7 $\mu\text{g/l}$) exceed the Maximum Tolerable Risk (MTR)-value of 1.5 $\mu\text{g/l}$.

At the NIEUWWTWG also the Zinc concentration of 15 $\mu\text{g/l}$ exceeds the MTR of 9.4 $\mu\text{g/l}$

4.3.2 Metals in Sediment

Sampling of the whole Dutch marine area is spread over 3 years. The measurement of concentrations in sediments has been part of the national programme since 1996, with each location being sampled once every 3 years. This national sediment-monitoring programme

includes all the locations that were sampled in the past for JMG and/or JAMP purposes. Sediments taken from the Dutch Delta in 2004 were assessed. All the peak values of the metal concentrations (table 9) underspend the Maximal Tolerable Risk (MTR)-values (table 18). Peak values exceed the “verwaarloosbaar risico-concentration” (VR) at: the Western Scheldt for As; Cd; Cr; Cu; Hg Pb and Zn; the Eastern Scheldt for As; Cr; Hg; Ni; Pb and Zn.

4.3.3 Metals in Biota

Flounders (*Platichthys flesus*, L) were caught at the Western Wadden Sea; the Coastal Zone; the Eastern Scheldt; the Ems-Dollard and the Western Scheldt.

Mussels (*Mytilus edulis*, L) were collected in the middle part of the Western Scheldt and in the Ems-Dollard estuary. Mercury concentrations were measured in female Dab muscle, male Flounder muscle and Mussels. Cadmium, Lead, Copper and Zinc were measured in female Dab liver, Cadmium in male Flounder liver and As, Cd, Cr, Cu, Hg, Pb and Zn in Mussels. The results are presented in table 10.

4.4 Organic contaminants

Organic contaminants are measured in three matrices in the Dutch marine area: 1) Water, 2) Sediment and 3) Biota. They are also measured in SPM but these measurements are not reported here since SPM is not part of JAMP.

4.4.1 Organic contaminants in Water

In table 11 the concentrations of hexachlorocyclohexane (HCH) and other pesticides in water are presented. A qualitative comparison of the results of γ -HCH in the period 1997 up to 2004 shows a significant decrease in the Western Scheldt of 88% (from 0.016 $\mu\text{g/l}$ to 0.0015 $\mu\text{g/l}$); see figure 5 page 34.

4.4.2 Organic contaminants in Sediment

Sediments taken from 2 areas in the Dutch Delta (Eastern Scheldt and Western Scheldt) in 2004 were assessed.

The peak value of PCB153 (15.0 $\mu\text{g/kg}$) exceeds the MTR (4 $\mu\text{g/kg}$) in the Western Scheldt.

All the Mean and peak values of BaP do not exceed the MTR of 3 mg/kg . However they all do exceed the VR of 3 $\mu\text{g/kg}$.

Despite the decreasing trend of TBT in the water matrix, the Median Value of TBT in de sediment matrix still exceeds the Maximal Tolerable Risk concentration (0.7 $\mu\text{g Sn/kg dry weight}$) by a factor 24 to 100.

4.4.3 Organic contaminants in Biota

Organic contaminants were measured in male Flounder liver and Mussels (ref. 16). The results are presented in table 13.

4.5 Biological effects

4.5.1 Fish disease

It is generally recognised that certain fish diseases are suitable indicators for monitoring anthropogenic environmental stress, including pollution (ref. 7). Long-term exposure to chemically contaminated sediment can induce liver tumours in Flounder (ref. 8).

Monitoring of the prevalence of externally visible diseases and liver nodules/tumours > 2mm is performed at all locations where Flounder are caught for monitoring of contaminants in biota. Details of these can be found in figure 1.

In 2004 Flounder (*Platichthys flesus*, L) was caught at three locations for determination of fish disease occurrence;

- Western Wadden Sea (WADDZWT)
- Coastal Zone (KUSTZNE)
- Eastern Scheldt (OOSTSDE)

Lymphocystis disease was not found at all three locations. The overall mean prevalence of skin ulcer was the highest at the Western Wadden Sea (4.6%) and less than 1% at the other two locations.

The results are presented in table 14.

The prevalences of disease in the period 1991-2004 at each location are presented in table 19. Note that most diseases are depending on length and sex (table 14) and that a proper analysis should take account of this. At first glance it can be deduced from the results that

- Skin ulcer in flounder occurs the most in the Wadden Sea from year to year between 1.0 and 12.7 % of the species caught. The relatively high prevalences of skin ulcers are related to the discharges of freshwater from the drainage sluices of the Afsluitdijk (Lake IJssel dam) (ref 18). At the other locations there seems a small decrease during the last 13 years.
- For Lymphocystis in the Wadden Sea a downward trend of 100% is detected in the period 1991-2005 (Except for the Eastern Scheldt at all locations liver nodules/tumours hardly occur from the mid nineties up to 2004. At the Eastern Scheldt liver nodules/ tumours occur almost every year (but recent cases have not histologically been confirmed yet).

5 Information on Quality Assurance

5.1 Introduction

This chapter contains what were originally called the National Comments. This is intended to be a document explaining the JAMP data reported to ICES so that they can be assessed properly. It contains information on quality assurance measures in relation to all data reported, as well as on intercalibration exercises and participation in QUASIMEME activities.

Methods of sampling and analysis are described in separate documents (ref. 9 to 11). These documents have been submitted to the OSPAR secretariat and ICES, but can also be supplied on request.

5.2 Quality assurance at the National Institute for Coastal and Marine Management/RIKZ

In order to compare results from different laboratories, it is essential to know the quality of the data. All the steps leading to their production influence this: sampling, transport, storage, analysis, calculation and interpretation. A minimum requirement to ensure the overall quality of data is a Quality Assurance System complying with the European Standard EN45001.

The policy of the Dutch government is that QA-procedures for sampling and analysis (in (non) governmental laboratories) must be accredited by the Dutch Accreditation Board (complying to the international standard). The RIKZ laboratory (which supplied most of the results discussed in this report) received accreditation in 1999. The RIZA and RIVO laboratories are accredited for the analyses they perform.

5.3 Sampling

Within the Ministry's Public Works and Water Management Department, several divisions are responsible for sampling (and preservation) on the one hand and chemical analysis on the other. This means that sampling is not subject to the Quality Assurance System of the laboratory. However, there is close and evident co-operation between the laboratory and the sampling groups. As a result, sampling procedures are well documented and the various sampling groups are implementing quality assurance systems. An external auditor will regularly audit the Quality Assurance Systems of the different Divisions.

5.4 Analysis

A quality control scheme has been established in order to provide information on the precision, accuracy and comparability of analysis (see figure 4). Control charts of Internal Reference Material (IRM) or Certified Reference Material are used for internal validation.

Intercalibration of the laboratories has been achieved through participation in appropriate national and international intercalibration

tests. All the Dutch laboratories that participate in the Joint Monitoring Programme are taking part in the QUASIMEME programme. A international Quality Assurance Control Scheme can be a powerful tool for achieving better comparability between different laboratories. Unfortunately, the number of laboratories available to carry out marine analyses in the Netherlands is too small to permit the development of a useful National Analytical Quality Control Scheme.

Results of analyses of Internal Reference Material or Certified Reference Material will be reported together with the monitoring data to ICES in 2005.

5.5 Detection limits

5.5.1 Seawater and sediment

Definition: The detection limit (DL) equals three times the standard deviation of the blank [S(bl)]:

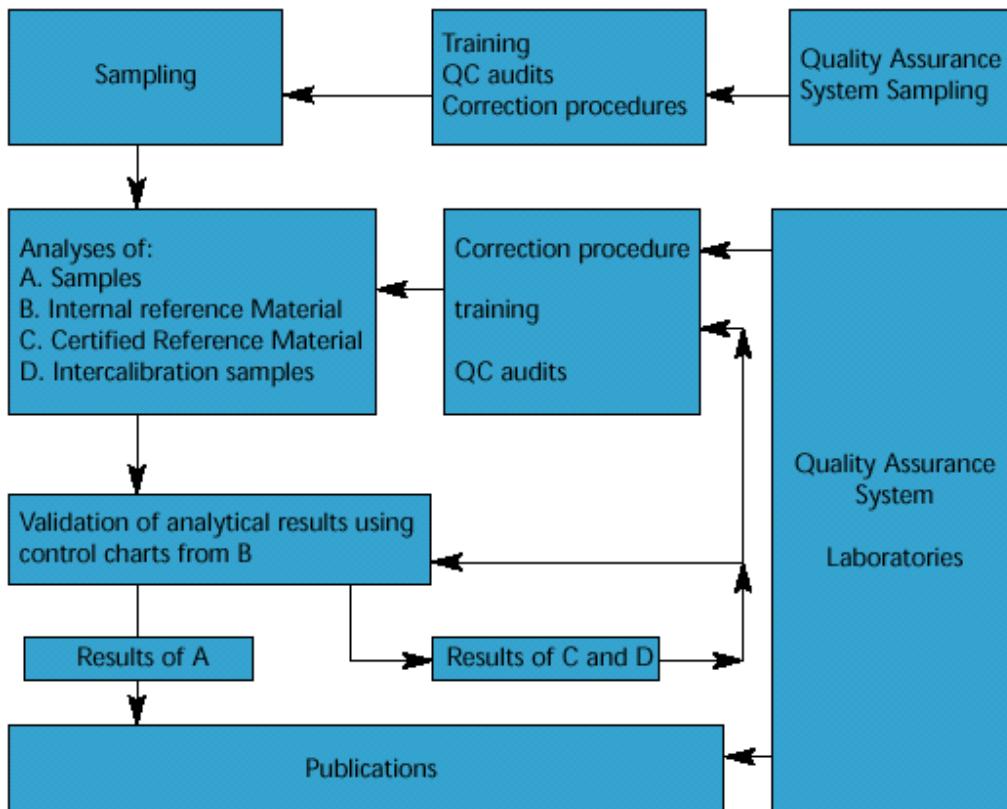
Formula 1: $DL = 3 * S(bl)$

This calculation of the detection limit is used for metals, nutrients and organic micro pollutants.

The detection limit depends on the amount of sample taken for the analysis. It is computed by taking the minimum amount of sample prescribed by the method. The blank is analysed ten times.

Numerical values for seawater and sediment are listed in table 15.

Figure 4. Analytical Quality Assurance Scheme.



5.5.2 Biota

The analyses of biological materials in biota are performed in the context of the JAMP monitoring programme by RIVO.

Definition of detection limit for trace metals:

The detection limit (DL) equals twice the standard deviation of the blank [S(b)]:

Formula 2: $DL = 2 * S(b)$

This formula for the detection limit is used for Mercury and Cadmium. The detection limit depends on the amount of sample taken for the analysis. It is computed by taking the minimum amount of sample prescribed by the method.

Definition for organic micro pollutants:

The detection limit equals three times the average of the noise [(X(r))]:

Formula 3: $DL = 3 * X(r)$

This formula for the detection limit is used for PCBs. The detection limit depends on the amount of sample taken for the analysis. It is computed by taking the minimum amount of sample prescribed by the method. Numerical values for biota are listed in table 15.

5.6 Intercalibration

All Dutch laboratories participating in the Joint Assessment and Monitoring Programme take part in the QUASIMEME programme. QUASIMEME intercalibration exercise rounds in which analysing laboratories participated in 2004 were:

Table 4. QUASIMEME codes for 2004

laboratory	round	exercise	group	parameter	matrix	IC-codes
RIKZ	34	581	AQ1	nutrients	sea water	M9 MA MB
RIKZ	34	582	AQ2	nutrients	low salinity water	MC MD ME MF
RIKZ	35	589	MS1	trace metals	sea water	MU MV MW
RIKZ	35	591	AQ5	HCHs	sea water	N1 N2 N3
RIKZ	35	594	AQ8	OPs & triazines	sea water	N8 N9 NA
RIKZ	36	599	MS1	trace metals	sediment	NK NL
RIKZ	36	600	MS2	OCPs & PCBs	sediment	NM NN
RIKZ	36	601	MS3	PAHs	sediment	NO NP
RIKZ	36	602	BT1	trace metals	biota	NQ NR
RIKZ	36	603	BT2	OCPs & PCBs	biota	NS NT
RIKZ	37	607	AQ3	trace metals	sea water	P3 P4 P5
RIKZ	37	609	AQ5	HCHs	sea water	P9 PA PB
RIKZ	37	612	AQ8	OPs & triazines	sea water	PG PH PI
RIVO	36	602	BT1	trace metals	biota	NQ NR
RIVO	36	603	BT2	OCPs & PCBs	biota	NS NT
RIVO	36	619	BT4	PAHs	biota	NX NY
RIVO	38	635	BT1	trace metals	sediment	OQ OR
RIVO	38	636	BT2	OCPs & PCBs	biota	OS OT
RIVO	38	637	BT4	PAHs	biota	OU OV

Reported data (with all the detailed information of the results of the desired intercalibration) of the Netherlands can be supplied on request by ICES.

6 Overall conclusions

Over the last 10 years, ortho-phosphate wintertime concentrations decreased by approx. 27%. This trend was more evident in a narrow strip (1-4 km) along the Dutch coast.

Overall, the wintertime concentration of ortho-phosphate on the Noordwijk transect is declining towards the objective background value of 0.02 mg P/L.

A similar trend was observed for total dissolved inorganic Nitrogen (DIN). Wintertime concentrations of DIN still exceed reference or background concentration by a factor of 3-4. This is most probably due to the additional N-inputs over the last two decades.

Concentrations of dissolved metals were in general low. Only at two locations Cu concentrations in water exceeded the Maximum Tolerable Risk concentration (MTR). At brackish water location (NIEUWWTWG) and a transitional water location (Western Scheldt), copper concentrations peaked at respectively 2.9 and 1.7 µg/L, thus exceeding the MTR of 1.5 µg/L. There, also a peak zinc concentration of 15 µg/L exceeded the MTR of 9.4 µg/L.

The 2004 assessment of the sediments taken in 2 areas in the Dutch Delta shows that all peak values of the metal concentrations underspend the Maximal Tolerable Risk-values. Peak values exceed the “verwaarloosbaar risico-concentratie” (VR) at: the Western Scheldt for As; Cd; Cr; Cu; Hg Pb and Zn; the Eastern Scheldt for As; Cr; Hg; Ni; Pb and Zn. No exceeding of the metal VR's occurs at the southern North Sea.

Concerning the organic contaminants in water, γ-HCH shows a major change in concentration during the last 8 years. A significant decrease of 88% is detected. The peak value of γ-HCH lies in 2004 a factor 600 beneath the MTR and a factor 6 beneath the VR.

The measured TBT concentrations in water show in agreement with earlier reported decreasing trends. Nevertheless, TBT concentrations in sediment still exceed the maximum tolerable risk concentration (set at 0.7 µg Sn/kg) by a factor of 24 to 100.

The prevalences of fish diseases in flounder (*Platichthys flesus*) in the period 1991-2005 at the different sites are presented in Table 19. It can be seen that skin ulcer occurs the most in the Wadden Sea between 1.0 and 12.7 % of the species caught. The high occurrence of skin ulcers in this part of the Wadden Sea is related to the discharge of fresh water through the drainage sluices of Lake IJssel (ref 18). At the other locations ulcers were generally less common or tended to decrease as of the second half of the nineties.

The occurrence of Lymphocystis and liver tumours in all areas sampled seemed generally lower than the period of a decade ago. The somewhat lowered occurrences of Lymphocystis in flounder. In general the prevalence of liver tumours in recent years is relatively low but not all cases have yet been histologically confirmed.

7 Tables

Table 5. Number of measurements (n) and median (M) and peak (P) values of supporting parameters in seawater in 2004.

Area	SALNTT			SPM in mg/l			T in °C			O ₂ in mg/l			Chlorophyll-a in µg/l in summer		
	n	M	P	n	M	P	n	M	P	n	M	P	n	M	P
WESTSDE	65	27.0	33.7	86	58	257	65	10.7	22.4	61	9.0	11.2	33	7.0	56.8
OOSTSDE	60	31.6	34.0	60	4	42	60	11.9	21.6	58	8.9	12.9	36	4.5	16.6
VOORDTA	35	32.7	33.9	33	24	121	35	11.6	21.1	35	8.4	13.1	11	4.8	31.2
NIEUWWTWG	-	-	-	26	18	104	26	12.9	24.2	24	8.8	13.3	25	4.0	30.0
KUSTZNE	53	32.1	34.2	62	6	44	53	12.2	20.6	53	9.0	14.2	34	4.7	36.0
ZUIDLKNZE	38	35.0	35.2	37	3	24	38	13.1	18.7	38	8.4	10.8	17	2.6	8.6
CENTLNZE	33	34.9	35.1	32	2	19	33	11.8	18.7	33	8.7	10.4	22	0.6	3.6
WADDZWT	51	25.7	31.9	55	21	180	51	10.3	21.7	51	8.9	12.1	15	7.7	36.2
WADDZOT	51	29.6	32.9	57	58	214	52	10.2	22.5	51	8.8	12.1	25	19.3	40.2
EEMSDLD	50	21.3	31.9	51	92	288	50	9.8	18.8	50	8.8	15.7	24	7.5	19.8

Table 6. Number of measurements (n) and median (M) and peak (P) values of Nitrogen, Phosphorus and Organic Carbon in seawater in 2004.

Area	Total Nitrogen in mg N/l			Total Phosphorus in mg P/l			Part. Org. Carbon in mg C/l			Total Org. Carbon in mg C/l		
	n	M	P	n	M	P	n	M	P	n	M	P
WESTSDE	53	1.97	5.06	47	0.21	0.36	61	1.1	3.9	60	4.1	8.7
OOSTSDE	60	0.66	1.31	60	0.06	0.11	60	0.3	2.4	59	2.2	3.4
VOORDTA	22	0.67	1.03	22	0.06	0.19	36	0.7	4.4	32	2.1	5.8
NIEUWWTWG	26	3.0	5.9	26	0.15	0.75	-	-	-	26	4.0	10.0
KUSTZNE	50	0.46	1.04	50	0.04	0.07	49	0.4	2.1	50	1.9	4.8
ZUIDLKNZE	36	0.17	0.25	37	0.02	0.04	39	0.2	1.2	37	1.1	3.1
CENTLNZE	32	0.12	0.28	32	0.02	0.03	28	0.1	0.2	32	1.0	1.8
WADDZWT	36	0.86	1.65	36	0.06	0.16	49	1.1	5.7	45	3.9	9.6
WADDZOT	49	1.00	2.02	49	0.12	0.28	54	2.5	6.6	49	5.5	11.6
EEMSDLD	42	2.12	6.17	41	0.19	1.00	53	3.5	13.0	44	8.1	18.6

Table 7. Number of measurements (n) and median (M) and peak (P) values of winter concentrations of nutrients in seawater in 2004. Winter period is from December 1st 2003 to March 1st 2004.

Area	NH ₄ in mg N/l			NO ₂ in mg N/l			NO ₃ in mg N/l			o-PO ₄ in mg P/l			SiO ₂ in mg Si/l		
	n	M	P	n	M	P	n	M	P	n	M	P	n	M	P
WESTSDE	16	0.11	0.39	16	0.032	0.079	16	1.4	3.9	16	0.09	0.15	16	1.1	3.8
OOSTSDE	9	0.14	0.19	9	0.021	0.035	9	0.4	0.9	9	0.04	0.06	9	0.4	0.8
VOORDTA	6	0.05	0.08	6	0.012	0.018	6	0.3	0.4	6	0.04	0.05	6	0.4	0.4
NIEUWWTWG	7	0.18	0.23	7	0.040	0.060	4	4.1	4.4	7	0.08	0.12	7	3.2	3.3
KUSTZNE	4	0.07	0.14	4	0.018	0.028	4	0.4	0.8	4	0.03	0.05	4	0.4	0.8
ZUIDLKNZE	4	<0.002	<0.002	4	0.005	0.008	4	0.1	0.1	4	0.02	0.02	4	0.1	0.1
CENTLNZE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WADDZWT	8	0.17	0.23	8	0.020	0.033	8	0.4	0.6	8	0.02	0.03	8	0.5	0.7
WADDZOT	6	0.24	0.28	6	0.033	0.039	9	0.4	0.9	6	0.04	0.05	6	0.7	1.1
EEMSDLD	8	0.23	0.37	8	0.056	0.064	8	1.7	4.2	8	0.07	0.08	8	2.5	4.4

Table 8. Number of measurements (n) and median (M) and peak (P) values of concentrations of dissolved inorganic contaminants in seawater in 2004.

Area	n	Cd in µg /L		n	Cu in µg /L		n	Ni in µg /L		n	Pb in µg /L		n	Zn in µg /L	
		M	P		M	P		M	P		M	P		M	P
WESTSDE	33	0.07	0.17	33	1.2	1.7	33	1.6	3.0	33	<0.3	0.3	33	1.1	9.2
NIEUWWTWG	26	<0.05	0.09	26	2.1	2.9	26	1.4	3.3	26	0.1	1.2	26	3.6	15
KUSTZNE	4	0.02	0.03	4	0.6	0.6	4	0.6	0.7	4	<0.3	<0.3	3	<1	<1
WADDZWT	4	<0.01	0.02	4	0.6	0.8	4	0.8	0.9	4	<0.3	<0.3	2	<1	<1
WADDZOT	4	<0.01	0.02	4	0.6	0.7	4	0.6	0.8	4	<0.3	<0.3	2	<1	<1
EEMSDLD	4	0.02	0.03	4	1	1.3	4	1.1	1.2	4	<0.3	<0.3	3	<1	1.1

Table 9. Number of measurements (n) and median (M) and peak (P) values of concentrations of inorganic metals in sediments in 2004.

Area	n	Al mg/kg		n	As mg/kg		n	Cd mg/kg		n	Cr mg/kg		n	Cu mg/kg	
		M	P		M	P		M	P		M	P		M	P
WESTSDE	12	40250	49600	12	22	35	12	0.9	3.8	12	110	150	12	24	58
OOSTSDE	10	40550	51000	10	18	49	10	0.5	0.7	10	84	110	10	19	27

Area	n	Hg mg/kg		n	Li mg/kg		n	Ni mg/kg		n	Pb mg/kg		n	Zn mg/kg	
		M	P		M	P		M	P		M	P		M	P
WESTSDE	12	0.4	0.7	12	41	56	12	28	32	12	64	91	12	210	390
OOSTSDE	10	0.3	0.4	10	44	53	10	26	36	10	50	90	10	150	250

Table 10. Number of measurements (n) and median (M) and peak (P) values of concentration of inorganic metals in biota in 2004.

Area	Species	Organ	n	As		n	Cd		n	Cr		n	Cu	
				M	P		M	P		M	P		M	P
WESTSDE	Mussel	soft body	4	7.1	7.9	4	6.0	7.7	4	4.7	4.9	4	10.4	10.8
EEMSDLD	Mussel	soft body	4	10.2	11.8	4	1.5	1.7	4	7.0	13.3	4	7.6	9.8
WESTSDE	Flounder	liver	-	-	-	24	0.3	1.0	-	-	-	-	-	-
EEMSDLD	Flounder	liver	-	-	-	21	0.4	0.7	-	-	-	-	-	-
WADDZWT	Flounder	liver	-	-	-	25	0.1	0.4	-	-	-	-	-	-

Area	Species	Organ	n	Hg		n	Ni		n	Pb		n	Zn	
				M	P		M	P		M	P		M	P
WESTSDE	Mussel	soft body	4	0.22	0.26	4	4.4	4.6	4	4.6	4.9	4	220	240
EEMSDLD	Mussel	soft body	4	0.33	0.36	4	5.9	7.3	4	5.1	6.8	4	163	188
WESTSDE	Flounder	muscle	24	0.27	0.64	-	-	-	-	-	-	-	-	-
EEMSDLD	Flounder	muscle	21	0.34	0.80	-	-	-	-	-	-	-	-	-
WADDZWT	Flounder	muscle	25	0.26	0.56	-	-	-	-	-	-	-	-	-

Table 11. Number of measurements (n) and median (M) and peak (P) values of concentrations of hexachlorocyclohexane in seawater in 2004.

Area	α-HCH in ug/l			β-HCH in ug/l			γ-HCH in ug/l		
	n	M	P	n	M	P	n	M	P
WESTSDE	37	<0.0001	0.0001	37	<0.0003	<0.0003	37	0.0006	0.0015
OOSTSDE	1	<0.0001	<0.0001	1	<0.0003	<0.0003	1	0.0003	0.0003
VOORDTA	1	<0.0001	<0.0001	1	<0.0003	<0.0003	1	0.0002	0.0002
NIEUWWTWG	13	<0.001	<0.001	13	<0.001	0.001	13	<0.001	0.003
KUSTZNE	4	<0.0001	0.0001	4	<0.0003	<0.0003	4	0.0002	0.0003
ZUIDLKNZE	-	-	-	-	-	-	-	-	-
CENTLNZE	1	<0.0001	<0.0001	1	<0.0003	<0.0003	1	<0.0001	<0.0001
WADDZWT	4	<0.0001	0.0001	4	<0.0003	<0.0003	4	0.0007	0.0012
WADDZOT	1	<0.0001	<0.0001	1	<0.0003	<0.0003	1	0.0013	0.0013
EEMSDLD	4	<0.0001	0.0001	4	<0.0003	<0.0003	4	0.0005	0.0012

Area	Atrazine ug/l			Diuron ug/l			Simazine ug/l		
	n	M	P	n	M	P	n	M	P
WESTSDE	36	0.024	0.065	36	0.125	0.29	36	0.013	0.039
OOSTSDE	8	0.0051	0.0064	8	0.039	0.058	8	<0.003	0.003
VOORDTA	12	0.0038	0.0049	12	0.012	0.017	12	<0.003	<0.005
NIEUWWTWG	13	0.01	0.03	26	0.04	0.09	13	<0.01	0.01
KUSTZNE	18	0.0034	0.0061	18	0.012	0.024	18	<0.003	<0.005
ZUIDLKNZE	8	<0.003	0.0017	8	<0.003	0.0037	8	<0.003	<0.005
CENTLNZE	6	<0.001	<0.003	6	<0.003	<0.003	6	<0.003	<0.003
WADDZWT	24	0.0055	0.0083	23	0.015	0.021	23	<0.003	0.0038
WADDZOT	11	<0.003	0.0045	11	0.012	0.025	11	<0.003	<0.005
EEMSDLD	23	0.0038	0.0078	23	0.032	0.066	23	<0.003	0.006

Figure 5. Trend of γ-HCH in filtered surface water in the Western Scheldt from 1997 to 2004.

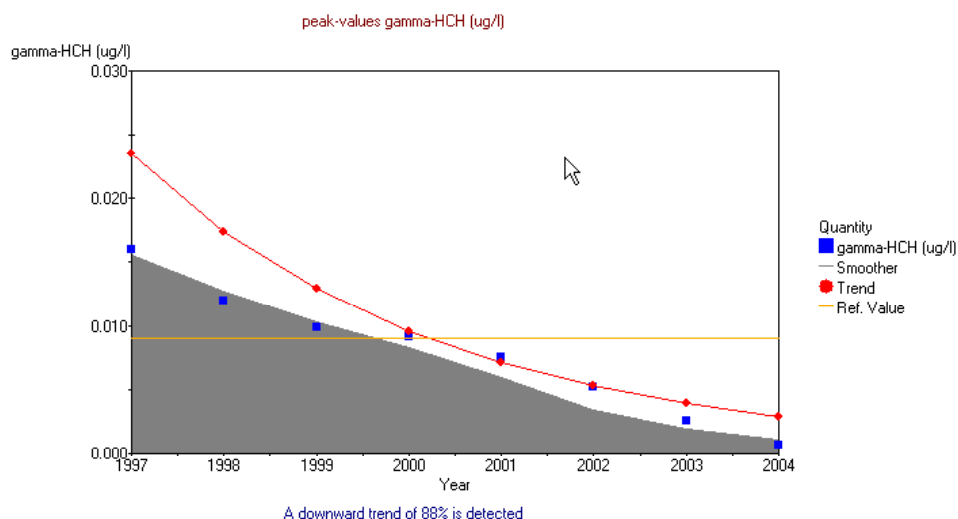


Table 12. Number of measurements (n) and median (M) and peak (P) values of concentrations of organic contaminants and Organic Carbon (OC) in sediments in 2004.

Area	n	PCB 153 µg/kg		n	Σ7PCB µg/kg		n	BaP µg/kg		n	Σ6PAH µg/kg		n	TBT µg Sn/kg		n	HCB µg/kg		n	OC % ww	
		M	P		M	P		M	P		M	P		M	P		M	P			
WESTSDE	12	3.8	15.0	12	13.1	57.0	12	87	240	12	650	1640	12	70	110	12	0.2	1.5	12	1.9	2.5
OOSTSDE	10	1.9	2.7	10	7.1	10.2	10	61	110	10	485	793	10	17	36	10	0.2	0.6	9	2.6	4.7

Table 13. Number of measurements (n) and median (M) and peak (P) values of concentrations of organic contaminants in biota in 2004, expressed as µg/kg wet weight, µg/kg dry weight and µg/kg fat.

Area	Species	Organ	n	Σ7PCB in ug/kg ww		n	Σ7PCB in ug/kg dw		n	Σ7PCB in ug/kg fat		n	Σ6PAH in ug/kg ww		n	Σ6PAH in ug/kg dw		n	Σ6PAH in ug/kg fat	
				M	P		M	P		M	P		M	P		M	P		M	P
WADDZWT	Flounder - male	liver	25	59	174	25	220	450	25	400	880	-	-	-	-	-	-	-	-	
WESTSDE	Flounder - male	liver	25	971	3137	25	2900	9100	25	5200	16200	-	-	-	-	-	-	-	-	
EEMSDLD	Flounder - male	liver	20	70	270	20	260	590	20	670	950	-	-	-	-	-	-	-	-	
WESTSDE	Mussel	soft body	5	42	60	5	330	380	5	3700	4300	5	40	48	5	273	306	5	2800	3400
EEMSDLD	Mussel	soft body	4	6.5	7.8	4	50	61	4	710	780	4	24	34	4	188	252	4	3200	4000

Area	Species	Organ	n	PCB153 µg/kg dw		n	Dieldrin µg/kg dw		n	BaP µg/kg dw		n	4.4'-DDT µg/kg dw	
				M	P		M	P		M	P		M	P
WESTSDE	Mussel	soft body	5	139	167	5	7.0	7.8	5	23	26	5	0.6	1.0
EEMSDLD	Mussel	soft body	4	22	27	4	1.6	1.6	4	18	26	4	0.6	0.6

Table 14. Prevalence of fish diseases in biota in 2004 in various size classes.

location WADDZWT	FLOUNDER (Platichthys Flesus) male					FLOUNDER (Platichthys Flesus) female					overall total	
	20-24cm	25-29cm	>29cm	n	Perc.(%)	15-19cm	20-24cm	>25cm	n	Perc.(%)	n	Perc.(%)
number of specimen	48	75	26	149	100.0	56	31	45	132	100.0	281	100.0
affected with:												
lymphocystis	0	0	0	0	0.0	0	0	0	0	0.0	0	0.0
skin ulcer	1	3	0	4	2.7	3	3	3	9	6.8	13	4.6
liver nodule/tumour	-	0	0	0	0.0	-	0	0	0	0.0	0	0.0

location OOSTSDE	FLOUNDER (Platichthys Flesus) male					FLOUNDER (Platichthys Flesus) female					overall total	
	20-24cm	25-29cm	>29cm	n	Perc.(%)	15-19cm	20-24cm	>25cm	n	Perc.(%)	n	Perc.(%)
number of specimen	54	70	20	144	100.0	51	38	43	132	100.0	276	100.0
affected with:												
lymphocystis	0	0	0	0	0.0	0	0	0	0	0.0	0	0.0
skin ulcer	1	0	0	1	0.7	0	0	0	0	0.0	1	0.4
liver nodule/tumour	-	0	0	0	0.0	-	0	0	0	0.0	0	0.0

location KUSTZNE	FLOUNDER (Platichthys Flesus) male					FLOUNDER (Platichthys Flesus) female					overall total	
	20-24cm	25-29cm	>29cm	n	Perc.(%)	15-19cm	20-24cm	>25cm	n	Perc.(%)	n	Perc.(%)
number of specimen	57	60	18	135	100.0	51	24	49	124	100.0	259	100.0
affected with:												
lymphocystis	0	0	0	0	0.0	0	0	0	0	0.0	0	0.0
skin ulcer	0	2	0	2	1.3	0	0	0	0	0.0	2	0.7
liver nodule/tumour	-	0	0	0	0.0	-	0	0	0	0.0	0	0.0

Table 15. Detection limits of all analyses used for JAMP monitoring by the laboratories involved.

Compartment Parameter	Seawater		Biota		Sediment
	RIKZ	RIZA	Fish (RIVO)	Mussel (RIKZ)	
	mg/m ³		mg/kg ww		mg/kg ww
Mercury	-	-	0.01	0.01	0.05
Cadmium	0.01	0.02	0.003	0.003	0.01
Copper	0.1	0.01	0.1	0.03	0.2
Zinc	1	0.3	0.6	0.5	2
Lead	0.3	0.1	0.02	0.1	0.2
Nickel	0.3	0.08	0.04	0.03	0.2
Chromium	-	-	0.05	0.1	0.5
Arsenic	-	-	0.5	0.05	1
Nitrite-N	1	2	-	-	-
Nitrate-N	3	20	-	-	-
Ammonium-N	1	50	-	-	-
Total-N	22	-	-	-	-
Ortho-P	1	5	-	-	-
Total-P	5	10	-	-	-
Silicon-SiO ₂	3	10	-	-	-
Chlorophyll	0.02	0.02	-	-	-
	mg/L				
SPM	1	1			
	ng/kg	pg/L	µg/kg ww		µg/kg ww
HCB	-	-	1	0.3	0.3
PCB28	-	-	1	0.5	0.5
PCB52	-	-	1	0.5	0.5
PCB101	-	-	1	0.3	0.3
PCB118	-	-	1	0.3	0.3
PCB138	-	-	1	0.3	0.3
PCB153	-	-	1	0.5	0.5
PCB180	-	-	1	0.3	0.3
PCB187	-	-	1	0.5	0.5
Phenanthrene	-	-	0.1	5	5
other PAHs	-	-	0.1	3	3
γ-HCH	0.1	0.1	-	0.1	-
Dieldrin	-	-	-	0.1	-
DDT	-	-	-	0.1	-
TBT (Sn)	3	-	-	1.0 (dw)	1.0 (dw)
Atrazine	1	-	-	-	-
Simazine	3	-	-	-	-
Diuron	1	-	-	-	-

Table 16. Locations used for calculating median and peak values for different areas of Dutch marine waters.

Compartment => Organism => Area	Water	Flounders	Mussel
<i>Western Scheldt</i> WESTSDE	Locations WIELGN VLISSGBISSVH TERNZBI20 HANSWG LAMSWDBI59	Locations MIDDGBWPMLPT	Locations HOEDKKKB14
<i>Eastern Scheldt</i> OOSTSDE	ZIJPE LODSGT WISSKKE	WISSKKE	
<i>Voordelta</i> VOORDTA	WALCNR2 SCHOUWN10 GOERE6		
<i>New Waterway</i> NIEUWWTWG	MAASSS		
<i>North Sea Coast</i> KUSTZNE	NOORDWK2 NOORDWK20 TERSLG4	NOORDWK2	
<i>Southern North Sea</i> ZUIDLKNZE	WALCRN70 NOORDWK70 TERSLG50		
<i>Central North Sea</i> CENTLNZE	TERSLG135 TERSLG235		
<i>Western Wadden Sea</i> WADDZWT	MARSDND DOOVBWT DOOVBOT BLAUWSOT	WIERBASDP	
<i>Eastern Wadden Sea</i> WADDZOT	DANTZGT ZOUTKPLG ZUIDOLWOT		
<i>Ems-Dollard estuary</i> EEMSDLD	HUIBGOT BOCHTVWTND BOCHTVWTM GROOTGND	PAAPGTGRDPT	BOCHTVWTM

Table 17. Locations used for calculating median and peak values in sediment for different areas of Dutch marine waters.

Area Area code	No	Location codes	Longitude N.			Latitude E.		
			°	'	''	°	'	''
<i>Eastern Scheldt</i>								
OOSTSDE	10	HAMMOT	3	51	10.48	51	39	40.06
	49	KRAMMR	4	5	44.18	51	40	1.94
	50	MARLGOT	4	11	59.82	51	28	33.29
	51	PIETMKK	4	7	54.06	51	29	51.63
	52	ROGGPND	3	47	32.38	51	41	9.39
	53	SCHAARVCLPOT	3	51	17.62	51	36	39.87
	54	SCHAARVCLPWT	3	48	23.41	51	36	41.43
	55	STAVNSKTN	4	0	55.73	51	36	4.64
	56	WILHMNDGGPT	3	55	31.56	51	33	2.69
	12	ZIJPE	4	5	50.04	51	38	44.32
<i>Western Scheldt</i>								
WESTSDE	57	BAARLDPL	3	54	3.40	51	22	24.91
	58	BATHBI68	4	12	25.86	51	23	28.51
	59	BATHBI71	4	9	56.48	51	23	4.47
	60	BORSLDPL	3	42	21.99	51	23	52.48
	61	HANSWBIOHMG	3	59	27.27	51	26	27.37
	6	HOEDKKKBI4	3	55	14.91	51	25	33.55
	62	KRUIINGPPDR	4	1	43.85	51	25	12.37
	2	SCHAARVODDL	4	15	3.36	51	21	4.26
	63	SPEELMGT	4	6	34.65	51	21	35.56
	64	TERNZBIWPT2	3	49	32.08	51	21	2.06
	7	VLISSGBISSVH	3	33	56.86	51	24	46.40
	65	WIELGOT	3	30	13.99	51	25	18.46

Table 18. Dutch environmental quality standards 2000 (ref.24).

Parameter		Surface water (dissolved)		
		Background concentration North Sea	Target value (VR)	Maximal Tolerable Risk concentration (MTR)
As	µg/L	-	1	25
Cd	µg/L	0.03 (n)	0.08	0.4
Cr	µg/L	-	0.3	8.7
Cu	µg/L	0.3 (n)	0.5	1.5
Hg	µg/L	0.003 (n)	0.01	0.2
Ni	µg/L	-	3.3	5.1
Pb	µg/L	0.02 (n)	0.3	11
Zn	µg/L	0.4 (n)	2.9	9.4
Chlorophyll-a	µg/L	-	-	100 (z)
DIN	mg N/L	0.15 (w)	-	-
total-N	mg N/L	-	1 (z)	2.2 (z)
o-PO4	mg P/L	0.02 (w)	-	-
total-P	mg P/L	-	0.05 (z)	0.15 (z)
BaP	µg/L	-	0.002	0.05
HCB	ng/L	-	0.09	9
PCB153	-	-	-	-
a-HCH	ng/L	-	33	3300
b-HCH	ng/L	-	9	800
g-HCH	ng/L	-	9	910
Atrazine	ng/L	-	29	2900
Diuron	ng/L	-	4	430
Simazine	ng/L	-	1!	140!
TBT	ng/L	-	0.01	1

Parameter		Sediment (d.w.)	
		Target value (VR)	Maximal Tolerable Risk concentration (MTR)
As	mg/kg	29	55 #
Cd	mg/kg	0.8	12 #
Cr	mg/kg	100	380 #
Cu	mg/kg	36	73
Hg	mg/kg	0.3	10 #
Ni	mg/kg	35	44
Pb	mg/kg	85	530 #
Zn	mg/kg	140	620
Chlorophyll-a	-	-	-
DIN	-	-	-
total-N	-	-	-
o-PO4	-	-	-
total-P	-	-	-
BaP	mg/kg	0.003 *	3 *
HCB	µg/kg	0.05	5
PCB153	µg/kg	4	4
a-HCH	µg/kg	3	290
b-HCH	µg/kg	9	920
g-HCH	µg/kg	0.05	230
Atrazine	µg/kg	0.2!	26
Diuron	µg/kg	0.08!	9
Simazine	µg/kg	0.009!	0.9!
TBT	µg/kg	0.007	0.7

n	90-percentile value
#	single value
!	uncertainty factor at deduction of 10, due to the lack of sufficient data
*	if OS<10%, no standardization
w	winter time value (1 December to 1 March)
z	summer time value (1 April to 1 October)
d.w.	dry weight
DIN	Dissolved Inorganic Nitrogen

Table 19. Prevalence of fish disease in flounder in the period 1991 - 2004 (in percentages).

Incidence of fish disease in flounder in the period 1991 - 2004 (in percentages)

Year	Wadden Sea			Eastern Scheldt			Coastal Zone		
	Skin ulcer	Lymphocystis	Liver tumour	Skin ulcer	Lymphocystis	Liver tumour	Skin ulcer	Lymphocystis	Liver tumour
1991	12.7	5.2	0	2.3	4.3	0.3	1.9	5.3	1.1
1992	8.4	3.2	0	0.9	2	1	2.9	1.5	0
1993	9	8.1	1.8	0	0.7	1.2	2.3	2.7	1.1
1994	1.8	4.5	1	0.3	1.3	0	1.8	4.5	0.6
1995	4.7	1.6	0.8	0.4	0.4	2.5	3.9	1.5	0
1996	10.8	0.9	0	0	0.3	1.9	1.3	0.3	0
1997	5.5	0.3	0	0	0.6	0	0.3	4	0
1998	7.1	1.6	0	0	0.4	0.6	2	2.6	0
1999	6.1	0	0	0	0.5	0.8	0.7	1.7	0
2000	7.1	0	0	0	1.4	0	1.6	1	0.5
2001	10.3	0.4	0	-	-	-	-	-	-
2002	3.8	6.6	4.1	0.4	0	1.9	0	1.1	0
2003	1.0	0	2.0	-	-	-	-	-	-
2004	4.6	0	0	0.4	0	0	0.7	0	0

Year	Western Scheldt			Ems Dollard estuary		
	Skin ulcer	Lymphocystis	Liver tumour	Skin ulcer	Lymphocystis	Liver tumour
1991	1	2.3	0.5	2	3.2	0
1992	0.7	0.7	2.2	3.5	2.4	0
1993	1.5	1.5	1.2	1.3	3.6	0.8
1994	0.8	0.4	0	0.8	0.5	0
1995	0	0	0	0	0	0
1996	0.7	0	0	0.5	1	0
1997	0.6	0.6	0	1	0	0
1998	0.4	0.8	0	0	1.7	0
1999	0.5	1.9	0	0	0.4	0
2000	-	-	-	-	-	-
2001	-	-	-	-	-	-
2002	-	-	-	-	-	-
2003	-	-	-	-	-	-
2004	-	-	-	-	-	-

Table 20. List of abbreviations and technical terms.

Σ7PCB	Sum of PCB congeners: 28, 52, 101, 118, 138, 153 and 180
Σ6PAH	Sum of 6 PAHs: Flu, B(b)F, B(k)F, B(a)P, B(ghi)P, InP
ABM	Active Biological Monitoring
ASMO	OSPAR working group on Assessment and Monitoring
ADHOCMON	SIME AD HOC working group on Monitoring
As	Arsenic
B(b)F	Benzo[b]fluoranthene
B(k)F	Benzo[k]fluoranthene
B(a)P	Benzo[a]pyrene
B(ghi)P	Benzo[ghi]perylene
Cd	Cadmium
Chr	Chrysene
Cl	Chloride
Cr	Chromium
Cu	Copper
Dab	<i>Limanda limanda</i>
DbahAnt	Dibenz(ah)anthracene
DL	Detection limit
DONAR	Data Opslag Natte Rijkswaterstaat (water data bank of the Netherlands)
dw	Dry weight
Flounder	<i>Platichthys flesus</i>
Flu	Fluoranthene
HCB	Hexachlorobenzene
HCH (α, β, γ)	Hexachlorocyclohexane (γHCH = Lindane)
Hg	Mercury
ICES	International Council for the Exploration of the Sea
InP	Indeno[1,2,3]pyrene
INPUT	ASMO working group on Input
JAMP	Joint Assessment and Monitoring Programme
JMG	Joint Monitoring Group
JMP	Joint Monitoring Programme
Mussel	<i>Mytilus edulis</i>
M	Median value
MTR	Maximum Tolerable Risk
n	Number of analysis
NH ₄	Ammonium
Ni	Nickel
NO ₂	Nitrite
NO ₃	Nitrate
NUT	OSPAR working group on Eutrophication
O ₂	Oxygen
OCPs	Organo Chlorine Pesticides
Ops	Organo Phosphorous Pesticides
o-PO ₄	Ortho-phosphate (=dissolved phosphate)
P	Peak value
PAHs	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB (n)	Polychlorobiphenyls (IUPAC- Number of the congener)
Pyr	Pyrene
QSR2000	Quality Status Report 2000
QA	Quality Assurance
QUASIMEME	Quality Assurance Laboratory Performance Studies for Environmental Measurements in Marine Samples.
RIKZ	National Institute for Coastal and Marine Management
RIVO	National Institute for Fisheries Research

RTT II	ASMO Regional Task Team II (North Sea)
SALNTT	Salinity
S(bl)	Standard deviation of the blank
SIME	ASMO working group on Substances in the Marine Environment
SiO ₂	Silicate
SPM	Suspended matter
T	Temperature
VR	Verwaarloosbaar risico concentratie (negligible risk concentration)
X(r)	Average of the noise
ww	Wet weight
Zn	Zinc

8 References

1. Klein, A.W.O., van Buuren, J.T. 1992. Eutrophication of the North Sea in the Dutch coastal zone 1976-1990. Tidal Waters Division report, WS 92.003.
2. Laane, R.W.P.M., van der Meer, J., de Vries, A., van der Giesen, A. 1989. Monitoring the progress of attempts to reduce nutrient load and inputs of certain compounds in the North Sea by 50%. Tidal Waters Division report GWAO-89.008.
3. Zevenboom, W., Vransen, R.G., Orth, R.C., van Zeijl, W.J.M., de Vries, I. 1996. Trends in winter nutrient concentrations in the Dutch North Sea waters. Report NZ-96.08, EUT (2) 96/3/2.
4. Van Bennekom, A.J., Wetsteyn, L.F.M.J. 1990. The winter distribution of nutrients in the southern Bight of the North Sea and in the estuaries of the Scheldt and the Rhine/Meuse. Netherlands Journal Sea Research, 25: 75-87.
5. Zevenboom, W., Orth, R.C., Peperzak, L., Rademaker, M., Vransen, R.G., de Vries, I. 1995. Assessment criteria for eutrophication and its effects (DPEUT 95/4/1), Report NZ-95.12.
6. Anonymous, 1994. An update on nutrients, eutrophication symptoms and problem areas in the Dutch part of the North Sea, 1976-1992. EUT 1/2/1; ASMO 95/7/INFO1
7. Vethaak, A.D., ap Rheinallt, T., 1992. Fish disease as a monitor of marine pollution: case of the North Sea. Rev. in Fish Biology and Fisheries 2: 1-32.
8. Vethaak, A.D. et al. 1996. Skin and liver disease induced in Flounder (*Platichthys Flesus*) after long-term exposure to contaminated sediments in large-scale mesocosmos, Envir. Health Persp. 104:1218-1229.
9. Bovelander, R., 2003. List of analytical methods used for seawater contaminants with matching codes, Working document RIKZ-MI/2003.013X.
10. Bovelander, R., 2003. List of analytical methods used for sediment samples contaminants with matching codes, Working document RIKZ-MI/2003.007X.
11. Van Zeijl, W.J.M., 2002. List of analytical methods used for biota samples contaminants with matching codes, Working document RIKZ-IT/2002.116X.
12. Swertz, O.C., Laane, R.W.P.M., Kramer, K.J.M., 1996. Assessment of Water Quality Monitoring in the Dutch Coastal Zone: Needs, Aims and Optimisation, Proceedings of Monitoring Tailor-made II 287-296.
13. RIKZ and RIZA, 2000, Jaarboek Monitoring Rijkswateren 1999.
14. OSPARCOM, 1998, Integrated assessment of inputs to the OSPAR Convention area 1990-1996. Outcome of INPUT Special Assessment Workshop, The Hague 26-27 March 1998. Environmental Assessment and Monitoring Committee (ASMO), 122 pp.
15. Bovelander, R.W., Langenberg, V.T., 2005, National Evaluation Report of the Joint Assessment and Monitoring Programme of the Netherlands 2003, RIKZ report RIKZ-2005.010.
16. Kotterman, M.J.J., 2003, Results of the RWS-RIKZ JAMP 2002 monitoring programme of flounder (*Platichthys flesus* L.): biological

- data of flounder and hazardous environmental compound in flounder and mussels., RIVO report C0028/03.
17. C. van Guchte, M. Beek, J. Tuinstra and M. van Rossenberg; Commissie Integraal Waterbeheer; Normen voor waterbeheer; mei 2000
 18. Vethaak, Dick. Johan Jol en Jan Pieters, 2004. Fish disease and drainage sluices: an investigation of disease in flounder (*Platichthys flesus*) in front of and behind the Lake IJssel drainage sluices. Final report covering research period 1988-2001. RIKZ, The Hague. Report RIKZ - 2004.003