Assessment and Monitoring Series

2005 Assessment of data collected under the OSPAR Comprehensive Study on Riverine Inputs and Direct Discharges for the period 1990 – 2002

OSPAR Commission

2005

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.

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Executive Summary

Inputs of heavy metals to the Sea widely and substantially reduced –
Reductions of nutrient inputs less consistent

A scientific assessment of data collected over 13 years (1990 – 2002) of inputs to the sea through rivers, and from direct discharges, in OSPAR Contracting Parties shows widespread and substantial reductions in inputs of heavy metals (Cadmium, Mercury and Lead). There were also some significant reductions in inputs of plant nutrients (Nitrogen and Phosphorus), but these were less consistent. Some important gaps need to be filled, and further investigation is needed of some of the features observed.

The OSPAR Comprehensive Study on Riverine Inputs and Direct Discharges (RID) collects information on waterborne loads of nutrients and hazardous substances reaching the sea. This assessment of their trends over time and space covers the data collected for the years 1990 to 2002. Riverine inputs are based on the loads crossing the freshwater limit into tidal waters. Direct discharges are discharges (for example, through pipelines) directly into the sea.

The assessment focuses on the inputs of nutrients (Nitrogen and Phosphorus), and three heavy metals (Cadmium, Mercury and Lead). The RID study includes some further determinands but adequate time-series are not yet available. The assessment covers three of the five OSPAR regions: Region I (Arctic Waters), Region II (Greater North Sea), Region III (Celtic Seas). Region IV (Bay of Biscay/Golfe de Gascogne and the Iberian Coast) and Region V (Wider Atlantic) have been omitted because in Region IV few or no time-series are currently available, and in Region V no significant riverine or direct discharges exist. In the assessment of the Greater North Sea, separate assessments have been made for its four sub-regions and for five assessment units of the North Sea Main Body.

The aim of the study is to collect data for the riverine inputs from major river catchments and direct inputs of the OSPAR Contracting Parties[1], representing at least 90% of total inputs. The remaining inputs are estimated, often on the basis of less frequent monitoring. The data from each country have been aggregated to give the loads delivered to the various regions and sub-regions. Trend assessment has then been applied to riverine inputs to each region and sub-region, to direct discharges to each region and sub-region, and to the aggregate loads composed of both.

Since riverine inputs depend on the river flow from the catchments, the loads can be affected significantly by the level of river flow, which in turn reflects rainfall in the catchment. The total load can often be affected by the amount of the river flow. Concentrations of contaminants in the water can also be affected by the level of flow (for example, heavy rain can lead to higher level of a contaminant leaching out from the land). Where the load was flow-dependent, the riverine load data have been normalised for flow levels. Where both load and concentration were flow-dependent, no normalisation has been applied, but the results have been regarded as “provisional”.

For ***heavy metals***, there has in general been a significant reduction in inputs:

a. in the Arctic Waters, there have been statistically significant downward trends in aggregate inputs of cadmium (down 89%, 1990 – 2002[2]) and lead (down 87%) and in direct discharges of mercury (down 91%). For riverine inputs of mercury, inputs in 2002 were lower than in 1990, but calculations show an upward trend, although not a statistically significant one. The total level of mercury inputs is still well under 0.5 tonnes a year;

[1] Belgium (3 major and 8 minor rivers), Denmark (2 major and 23 minor rivers), France (River Seine only), Germany (3 major and 1 minor rivers), Ireland (10 major and 9 minor rivers (minor rivers estimated)), the Netherlands (10 major rivers and estimates of other inputs), Norway (10 major rivers, together with less extensive measurement of 36 tributary river systems and estimation), Portugal (River Tagus only), Spain (3 major and 39 minor rivers), Sweden (9 major and 8 minor rivers), and the United Kingdom (16 major rivers). Iceland plans to monitor riverine inputs. Finland, Luxembourg and Switzerland do not participate.

[2] Unless otherwise stated, all other changes are over this period.

b. in the Greater North Sea, there have been major and statistically significant downward trends in total inputs of cadmium (down 49%), lead (down 33%) and mercury (73%). Generally, direct discharges were the smaller and progressively diminishing component of overall inputs for each substance;

c. in the Celtic Seas, there were major and statistically significant downward trends in total inputs of cadmium (down 68%) and of mercury in direct discharges (down 86%). Satisfactory results could not, however, be reached for riverine and total inputs of mercury (much data from Ireland is missing for 1999 – 2001) or any inputs of lead (data from Ireland contain anomalies). Total inputs in 2002 for all three metals were, however, substantially lower than in 1990. Generally, direct discharges to the Celtic Seas were the smaller and progressively diminishing component of overall inputs for each substance.

For ***nutrients***, the measurements are of the total nitrogen and the total phosphorous in the various compounds that are found. The picture is less uniform than for heavy metals:

a. in Arctic Waters, there were substantial and statistically significant increases in total inputs of both nitrogen (up 32%) and phosphorus (up 135%), as a result of significant increases in direct discharges (riverine inputs declined slightly (nitrogen) or stayed level (phosphorus));

b. in the Greater North Sea, there was a statistically significant reduction in total inputs of nitrogen (down 12%), which was substantially influenced by the 29% reduction in direct discharges. There was also a statistically significant reduction in direct discharges of phosphorus (down 33%), but no conclusion could be reached on riverine inputs, since the loads and concentrations were flow-dependent;

c. in the Celtic Seas, there was a statistically significant reduction in total inputs of phosphorus (down 33%), but no conclusions could be reached on inputs and discharges of nitrogen, because of missing data from Ireland for 1999 – 2001. Nevertheless, total inputs in 2002 were lower than in 1990.

In the sub-regional analysis of the Greater North Sea, the following elements stand out:

a. nearly all data from Denmark on direct discharges and riverine inputs of heavy metals to waters off the German and West Danish Coast and to the Kattegat are missing. The trends in these inputs are all downward, but some are not statistically significant. They need to be re-evaluated after inclusion of the missing data;

b. the assessment of the Channel could be based only on data from the UK. No significant trend could be observed for riverine and total inputs of mercury to the Channel. The trend analysis for mercury direct discharges is less clear because of missing data for 1995 and 1998. Riverine inputs of mercury were very low. The riverine and total inputs of total nitrogen and riverine inputs of phosphorus show a significant upward trend that is provisional due to missing normalisation parameters, nevertheless the cause of the increase needs to be investigated;

c. riverine inputs of phosphorus to the North West North Sea UK East Coast (North) showed a large and significant upward trend (up 42%) which cannot be explained, and which should be investigated;

d. direct discharges of nitrogen to the waters off the Belgian and Dutch Coast showed a significant upward trend (up 13%). Although direct discharges are only just over 1% of total inputs, the cause of the increase needs to be investigated;

e. the statistically significant increases in direct discharges of nitrogen (up 109%) and of direct discharges (up 153%), riverine loads (up 121%) and total inputs (up 138%) of phosphorus to waters off the Norwegian West Coast need to be verified to see whether they are genuine or an anomaly;

f. riverine inputs (up 76%) and total inputs (up 28%) of phosphorus to the Skagerrak increased significantly over 1990-2002, in spite of a 64% reduction of phosphorus in direct discharges. The reasons for these increases (driven by riverine loads from Norway from 1999 onwards) need to be established;

g. while direct discharges of nitrogen and phosphorus to the Kattegat have statistically significant downward trends (down more than 50%) and riverine inputs of total phosphorus show a statistically significant reduction (down 44%), the reduction in riverine inputs of total nitrogen was only 19% and was not statistically significant.

8. Recommendations for improving future assessments include enhancing completeness and consistency of data sets (particularly for Region III and Region IV) addressing the anomalies or gaps in data mentioned above and, subject to the availability of consistent data, extending the range of determinands assessed in detail and the spatial coverage and resolution of the assessments.

Récapitulatif

Réduction importante et généralisée des apports de métaux lourds à la mer –

Réduction des apports de nutriments moins régulière

Une évaluation scientifique des données recueillies pendant treize ans (de 1990 à 2002) qui porte sur les apports fluviaux et les rejets directs à la mer chez les Parties contractantes OSPAR, révèle une réduction considérable et généralisée des apports de métaux lourds (cadmium, mercure et plomb), ainsi qu'une réduction considérable des apports en nutriments provenant d'installations (azote et phosphore) bien que ces dernières soient moins régulières. Il convient de combler certaines lacunes et de poursuivre les recherches qui portent sur certaines caractéristiques qui ont été observées.

L'étude exhaustive OSPAR des apports fluviaux et des rejets directs (RID) recueille des informations sur les charges de nutriments et de substances dangereuses en suspension dans l'eau qui parviennent à la mer. La présente évaluation de leurs tendances spatiotemporelles s'intéresse aux données recueillies de 1990 à 2002. Les apports fluviaux se fondent sur les charges qui traversent la limite des eaux douces et pénètrent les eaux tidales. Les rejets directs sont des rejets (par exemple provenant de pipelines) qui se jettent directement dans la mer.

L'évaluation se concentre sur les apports de nutriments (azote et phosphore), et trois métaux lourds (cadmium, mercure et plomb). L'étude RID comporte quelques autres déterminands mais l'on ne dispose pas encore de séries de données adéquates. L'évaluation couvre trois des cinq régions OSPAR: Région I (Eaux arctiques), Région II (Mer du Nord au sens large) et Région III (Mers celtiques). La Région IV (Golfe de Gascogne et côtes ibériques) et la Région V (Atlantique au large) n'ont pas été incluses. En effet peu ou pas de séries temporelles sont actuellement disponibles pour la Région IV, et la Région V ne comporte pas d'apports fluviaux ou de rejets directs importants. L'évaluation de la mer du Nord au sens large consiste en des évaluations distinctes pour ses quatre sous-régions et pour les cinq unités d'évaluation de la Mer du Nord proprement dite.

L'objectif de l'étude est de recueillir des données sur les apports fluviaux provenant des principaux bassins hydrographiques et sur les apports directs des Parties contractantes OSPAR[3], qui représentent 90% au moins des apports totaux. Les autres apports sont estimés, souvent à partir d'une surveillance moins fréquente. Les données de chaque pays ont été agrégées pour obtenir les charges apportées aux diverses régions et sous-régions. L'évaluation des tendances a alors été effectuée pour les apports fluviaux dans chaque région et sous-région, pour les rejets directs dans chaque région et sous-région et pour les charges agrégées des apports et rejets.

Puisque les apports fluviaux dépendent du débit du bassin hydrographique, les charges peuvent être affectées de manière significative par le débit du fleuve, qui à son tour dépend des précipitations dans son bassin. La charge totale peut souvent être affectée par le débit du fleuve. Les teneurs en contaminants dans l'eau peuvent également être affectées par le débit du fleuve (par exemple, de fortes pluies peuvent entraîner un niveau élevé d'un contaminant par lixiviation). Lorsque la charge dépend du débit, les données sur la charge fluviale sont normalisées pour les débits. Lorsque la charge ainsi que la teneur dépendent du débit, aucune normalisation n'est appliquée mais les résultats sont considérés comme « provisoires ».

[3] Belgique (3 fleuves principaux et 8 petits), Danemark (2 principaux et 23 petits), France (la Seine seulement), Allemagne (3 principaux et 1 petit), Irlande (10 principaux et 9 petits (les petits fleuves ont été estimés)), Pays-Bas (10 principaux et autres apports estimés), Norvège (10 principaux, ainsi que des analyses moins intensives de 36 affluents et estimations), Portugal (le Tage seulement), Espagne (3 principaux et 39 petits), Suède (9 principaux et 8 petits), et Royaume-Uni (16 fleuves principaux). L'Islande prévoit de surveiller les apports fluviaux. La Finlande, le Luxembourg et la Suisse ne prennent pas part.

Pour les ***métaux lourds***, on relève, en général, une réduction importante des apports:

a. dans les eaux arctiques, on a relevé des tendances à la baisse statistiquement significatives dans les apports agrégés de cadmium (baisse de 89%, de 1990 à 2002[4]) et de plomb (baisse de 87%) et dans les rejets directs de mercure (baisse de 91%). Les apports fluviaux de mercure en 2002 sont inférieurs à ceux de 1990. Les calculs révèlent cependant une tendance à la hausse, bien que celle-ci ne soit pas statistiquement significative. La quantité totale des apports de mercure se situe encore bien en dessous de 0,5 tonnes par an;

b. dans la mer du Nord au sens large, on a relevé des tendances à la baisse importantes et statistiquement significatives des apports totaux de cadmium (baisse de 49%), de plomb (baisse de 33%) et de mercure (baisse de 73%). D'une manière générale, la contribution des rejets directs aux apports totaux est la moindre et elle est en baisse progressive pour chaque substance;

c. dans les mers celtiques, on a relevé des tendances à la baisse importantes et statistiquement significatives des apports totaux de cadmium (baisse de 68%) et de mercure dans les rejets directs (baisse de 86%). On n'obtient cependant pas de résultats satisfaisants pour les apports fluviaux et totaux de mercure (de nombreuses données irlandaises manquent de 1999 à 2001) ou pour les apports de plomb (les données irlandaises présentent des anomalies). Les apports totaux en 2002 pour les trois métaux sont cependant considérablement plus faibles qu'en 1990. D'une manière générale, la contribution des rejets directs aux apports totaux dans les mers celtiques est la moindre et en baisse progressive pour chaque substance.

Pour les ***nutriments***, les statistiques portent sur l'azote total et le phosphore total dans les divers composés trouvés. Le tableau est moins uniforme que pour les métaux lourds:

a. dans les eaux arctiques, on a relevé des augmentations importantes et statistiquement significatives des apports totaux d'azote (hausse de 32%) et de phosphore (hausse de 135%), du fait d'augmentations importantes des rejets directs (les apports fluviaux ont légèrement diminué pour l'azote et restent inchangés pour le phosphore);

b. dans la mer du Nord au sens large, on a relevé des réductions importantes et statistiquement significatives des apports totaux d'azote (baisse de 12%), ce qui est dû essentiellement à la réduction de 29% des rejets directs. On relève également une réduction statistiquement significative des rejets directs de phosphore (baisse de 33%). On ne peut cependant pas tirer de conclusions sur les apports fluviaux car les charges et les teneurs dépendent du débit;

c. dans les mers celtiques, on a relevé des réductions statistiquement significatives des apports totaux de phosphore (baisse de 33%). On ne peut cependant pas tirer de conclusions sur les apports et les rejets d'azote, cas les données de l'Irlande de 1999 à 2001 sont incomplètes. Les apports totaux en 2002 sont cependant inférieurs à ceux de 1990.

L'analyse des sous-régions de la mer du Nord au sens large met en évidence les éléments suivants:

a. presque toutes les données du Danemark, sur les rejets directs et les apports fluviaux de métaux lourds dans les eaux au large des côtes de l'Allemagne et du Danemark de l'ouest et dans les eaux du Kattegat, manquent. Les tendances de ces apports sont toutes à la baisse, mais certaines ne sont pas statistiquement significatives. Il est nécessaire de les évaluer à nouveau lorsque l'on aura inclus les données manquantes;

b. l'évaluation de la Manche peut se fonder uniquement sur les données du Royaume-Uni. On ne relève pas de données significatives pour les apports fluviaux et totaux de mercure dans la Manche. L'analyse des tendances pour les rejets directs de mercure est moins claire car il manque des données pour 1995 et 1998. Les apports fluviaux de mercure sont très bas. Les apports fluviaux et totaux d'azote total et les apports fluviaux de phosphore révèlent une tendance à la hausse significative. Celle-ci est provisoire car il manque des paramètres de normalisation, mais il est cependant nécessaire d'étudier la cause de cette augmentation;

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[4] Tous les autres changements concernent cette période, sauf indication du contraire.

c. les apports fluviaux de phosphore à la mer du Nord du nord-ouest (côte est du nord du Royaume-Uni) révèlent une tendance à la hausse importante et significative (hausse de 42%) qui ne s'explique pas et qu'il faudra étudier;

d. les rejets directs d'azote dans les eaux au large des côtes belges et néerlandaises révèlent une tendance à la hausse significative (hausse de 13%). Bien que les rejets directs ne représentent qu'un peu plus de 1% des apports totaux, il est nécessaire d'étudier la cause de cette hausse;

e. il faut vérifier les hausses statistiquement significatives des rejets directs d'azote (hausse de 109%) et des rejets directs (hausse de 153%), charges fluviales (hausse de 121%) et apports totaux (hausse de 138%) de phosphore dans les eaux au large de la côte ouest de la Norvège, ceci afin de déterminer si ces hausses sont réelles ou anormales;

f. les apports fluviaux (hausse de 76%) et les apports totaux (hausse de 28%) de phosphore dans le Skagerrak ont augmenté de manière significative de 1990 à 2002, en dépit d'une réduction de 64% des apports directs de phosphore. Il est nécessaire de déterminer les raisons de ces augmentations (entraînées par les charges fluviales de la Norvège à partir de 1999);

g. alors que les rejets directs d'azote et de phosphore dans le Kattegat révèlent des tendances à la baisse statistiquement significatives (baisse supérieure à 50%) et que les apports fluviaux de phosphore total révèlent une réduction statistiquement significative (baisse de 44%), la réduction des apports fluviaux d'azote total n'est que de 19% et elle n'est pas statistiquement significative.

8. Afin d'améliorer les évaluations futures, il est recommandé de communiquer des séries de données complètes et cohérentes (en particulier pour les Régions III et IV), de traiter les anomalies ou les lacunes des données ci-dessus mentionnées et, sous réserve que des données cohérentes soient disponibles, d'élargir la gamme des déterminands évalués de manière détaillée ainsi que la couverture et résolution spatiales des évaluations.

2005 Assessment of data collected under the OSPAR Comprehensive Study on Riverine Inputs and Direct Discharges for the period 1990 – 2002

1. Introduction

Inputs are the waterborne loads of substances carried to the maritime area of the OSPAR Convention by rivers and direct discharges. Guidance on the annual reporting of inputs to OSPAR is contained in the Principles of the Comprehensive Study on Riverine Inputs and Direct Discharges (RID Principles)[5]. The RID Principles include the definitions of direct discharges and riverine inputs and detail the objectives of the monitoring programme.

Inputs are important in that they provide information on one of the key links between the land-based sources of substances of concern and their presence and effects in the maritime area. They can give an indication of the effectiveness of the OSPAR Commission's policies and they assist in the interpretation of monitoring data such as those collected under the Joint Assessment and Monitoring Programme (JAMP)[6] of the OSPAR Commission.

This assessment supersedes previous assessments, namely the outcome of the Special Assessment Workshop of the OSPAR Working Group on Inputs to the Marine Environment (INPUT) held in The Hague on 26 - 27 March 1998 (INPUT (2) 98/6/1), the Limited Update of the 1998 RID Assessment undertaken by INPUT 2000 (see INPUT 00/16/2), and the 2001 RID assessment undertaken by INPUT 2001 (INPUT 01/18/1, Annex 5).

For the assessment, the latest version of the "JAMP Guidance on Input Trend Assessment and the Adjustment of Loads" (the "RTrend Guidance", reference number: 2003-9), as adopted by OSPAR 2003, was applied to the various sets of loads and flow data, and the flow-adjustment of riverine loads where appropriate. For the statistical analysis of loads, the software RTrend was used. In the course of this amendment, the RTrend software was further developed and the RTrend Guidance updated by OSPAR 2005. Consequently, some of the individual assessments have been made using a later version of the RTrend software than adopted by OSPAR 2003. This is considered to make no material difference to the overall results of the assessment.

2. Objective and scope of assessment

The objective of the work is to prepare an assessment of the levels of, and changes in, the riverine inputs and direct discharges to the OSPAR maritime area – see Figure 1. The assessment focused on the Arctic Waters (Region I), the Greater North Sea (Region II) and the Celtic Seas (Region III). Due to the limited time series of data currently available, an assessment of inputs into OSPAR Region IV, the Bay of Biscay and Iberian Coast, has not been made in this report. It is intended that such an assessment be considered for the next RID assessment. The assessment of Region II – the Greater North Sea – has been extended to include an assessment of its four sub-regions and of five smaller assessment units of the North Sea Main Body – see Figure 2.

The primary purpose of the assessment is to provide contributions to JAMP products HA-1 and EA-2[7] which require an assessment by 2005 of temporal trends and (where relevant/feasible) spatial distribution for the hazardous substances and nutrients where periodic sampling and analysis is undertaken, in particular under CAMP, CEMP and RID. The assessments will, however, also contribute to more general work on indicators.

The assessment period covers data from 1990 to 2002 and focuses on the inputs of the nutrients total Nitrogen and total Phosphorus, and the three heavy metals Cadmium, Mercury and Lead.

It is intended that this assessment will form the basis for future RID data assessments, taking into account the most up-to-date RID data. Subject to the availability of consistent data sets, it is intended to extend the range

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5 The RID Principles were adopted in 1998 and revised by ASMO 2005 (reference number: 1998-5).

6 The Joint Assessment and Monitoring Programme (JAMP) (reference number: 1997-17).

7 Assessment products set out in the 2003 Strategy for a Joint Assessment and Monitoring Programme (reference number: 2003-22), as amended by OSPAR 2004 and 2005.

of determinands assessed in detail, and the spatial coverage and resolution of the assessments. This assessment will provide a primary contribution to a holistic assessment of substances, and their loads, that enter the maritime area from sea-based as well as land-based sources.

3. Working procedure

This assessment was prepared by an assessment panel working primarily by correspondence. The following persons participated in the assessment panel: Chairman of INPUT (lead person) Mr Andrew Osborne (UK); Dr Heike Herata (Germany); Mr Mark Moens (Belgium); Mr Anders Widell (Sweden); and Dr Lars Svendsen (Denmark). A summary of the assessments is given in this document; the detailed assessments of the OSPAR regions and sub-regions are available in Annexes 1 to 12 to this report which are published in the "Assessment and Monitoring" section of the OSPAR website (http://www.ospar.org).

4. Data and assessed regions / sub-regions

The loads and riverine flow data used in the detailed assessments has been abstracted from a master data set of all RID data held by the OSPAR Secretariat. This data is presented in tabular form in sections 7 and 8 of this report dealing with the respective regions and sub-regions.

5. Limitations and preparation of data, including steps taken to deal with gaps and anomalies

The assessments contained in this report are based on the data which has been reported by Contracting Parties to OSPAR. Due to incomplete reporting by some Contracting Parties, the data contains gaps and anomalies which can distort any associated presentation of inputs in terms of their absolute levels or patterns of change. Generally, such gaps, anomalies or inconsistencies in reporting are acknowledged in the assessments and the discussion (sections 7 – 9) of this report.

There is a need to recognise that some Contracting Parties consistently report more fully than others and that, as the RID programme has progressed, reporting practice has tended to become more complete over time. Additionally, it should be noted that, for transboundary rivers, it is the Contracting Party furthest downstream that undertakes the RID survey work and reports the data to OSPAR. Consequently, there is a need to be careful in attributing inputs to any one Contracting Party or making comparisons between the inputs reported by different Contracting Parties.

In order to make this report manageable in terms of detail, and to relate inputs to suitable units of assessment, there has been a certain degree of aggregation of data. It should be noted that such aggregation can mask large, possibly significant, variations at the local scale.

As an initial step for this assessment, Contracting Parties were asked to review their data and, with the opportunity for scrutiny offered by a sequence of annual data sets, to identify, and if possible address, any gaps or anomalies in their data. Upon completion of the review, a record of, and justification for any associated adjustments to, the original data sets should be reported to OSPAR for transparency.

Generally, for a given site, most inputs are reported as a lower and as an upper estimate (reflecting the fact that some concentrations, upon which the estimate for the site is based, will be below the level of detection – see the RID Principles). In order to facilitate the assessment of data, the upper estimate has been used in the assessment of nutrients (acknowledging that, for nutrients, there is little if any difference between the lower and upper values) and heavy metals for the main OSPAR regions. For the assessment of the sub-regions of the Greater North Sea and the assessment units of the Main Body of the North Sea, a mean of the lower and upper estimates has been used for other determinands than for nutrients.

It should be noted that in the assessment of total Phosphorus, for UK inputs, data was available for Scotland and Northern Ireland but Ortho-phosphate Phosphorus data only was available for England and Wales. This will have affected the absolute values of inputs of total Phosphorus for the assessments concerned but have only marginal effect on the assessment of trends. Also, in respect of UK inputs, it should be noted that the contributions of Nitrogen and Phosphorus from fish farm sites have not been taken into account. Although such estimates have been made within OSPAR in the context of eutrophication assessment and reporting on nutrient sources, such reporting was not a requirement of reporting under the RID Principles applying for the period covered by this assessment. Although such inputs have increased during the period of assessment, their significance in the four assessment areas concerned (Region II, Region III, North Sea Main Body and North-West North Sea) is likely to be small given the levels of riverine and direct inputs.

6. Use of flow adjustment to reduce meteorological induced variabilities

Because of the major influence that riverine flow rate has on the absolute values of some riverine inputs, it is useful to apply flow adjustment to riverine inputs data in order to reduce meteorological induced variabilities and, thus, to more reliably evaluate any underlying trend in inputs.

In order to filter out these variabilities as effectively as possible for the anthropogenic input pattern to become clearer, adjustment procedures were developed ("JAMP Guidance on Input Trend Assessment and the Adjustment of Loads" and associated software RTrend). Due to the high variation of flow impact, a generally appropriate adjustment requires the use of monthly data. However, for the assessments of annual riverine inputs, the only procedure that is accepted at this moment from the statistical point of view is the "A0 method"[8]. This method takes into account only the flow-induced variability of the inputs by adjusting them to the long-term average flow. Whenever the regression analysis of the annual data indicates that the concentrations, calculated on the basis of loads and flow, are flow-dependent, the A0 method is not appropriate and will usually lead to over-adjustment. For this purpose, an adjustment method other than A0 is needed to filter out such flow variability. Because no such method is available at present for the assessment of annual loads, no adjustment could be applied in these cases. As a consequence, if a significant trend was found in the unadjusted annual loads, it could not be definitely attributed to the anthropogenic input variability itself.

Generally, direct discharges should not be adjusted for flow, but they still should be assessed for temporal trends. However, where there has been a significant step change in direct inputs, due for example to the relocation of a sewage effluent outfall from a riverine location to an estuary location downstream, such change was acknowledged in the assessment or in the discussion of results (sections 7 – 9).

The approach to flow-adjustment described above is taken into account by the RTrend software and guidance that was used throughout for the trend analysis of annual data only.

As a consequence, and in order to establish a consistent way to aggregate and assess the direct discharges and riverine loads, the following procedure was applied:

a. The riverine loads and concentrations were tested for flow-dependency through a regression analysis.

b. If only the loads were flow-dependent, the A0-adjustment was applied to give "flow-adjusted" riverine inputs, which were then added to the direct discharges. The trend analysis was performed on this sum.

c. If there was no flow-dependency of the loads, an A0-adjustment was not necessary, and consequently not applied. The unadjusted riverine inputs were added to the direct discharges. The trend analysis was performed on this sum.

d. If both the riverine loads and the concentrations were flow-dependent, an A0-adjustment was not performed since this method is not appropriate for this case and will usually lead to over-adjustment. In this case, the trend analysis was performed on the sum of aggregated direct discharges and riverine inputs. The results were given a provisional status (shown in square brackets) because, as explained above, no definite conclusions could be drawn with regard to the anthropogenic part of the riverine loads.

[8] "A0" is an adjustment method for annual load data which takes into account the ratio between the actual annual run-off and the long-term annual run-off".

7. Results of the assessments of inputs at regional level of the OSPAR Maritime Area

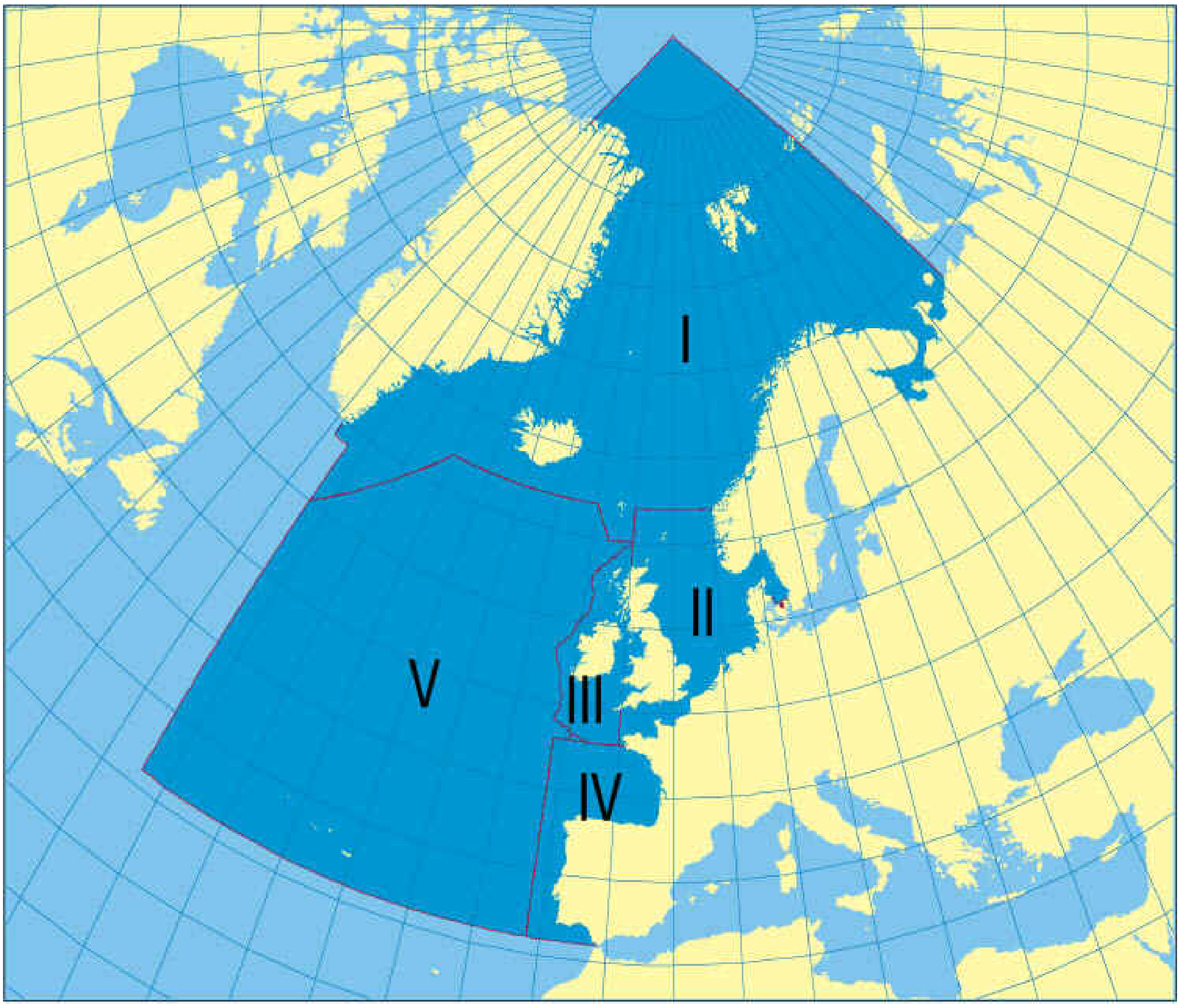


Figure 1: Map of the OSPAR maritime area showing the five OSPAR regions
Note: I = Arctic Waters; II = Greater North Sea; III = Celtic Seas; IV = Bay of Biscay and Iberian Coast; V = Wider Atlantic

A consideration of the overall inputs to Arctic Waters, the Greater North Sea and the Celtic Seas (Regions I, II and III of the OSPAR maritime area for which assessment of inputs data has been made in this report) shows that, generally, for the five substances which have been assessed, 65 – 80% of inputs are to Region II, 20 – 30% are to Region III, and less than 5% are to Region I. These proportions correlate well with those of the mean riverine flow rates to the three regions over the period of assessment, which are 75%, 22% and 3% of the total riverine flow respectively.

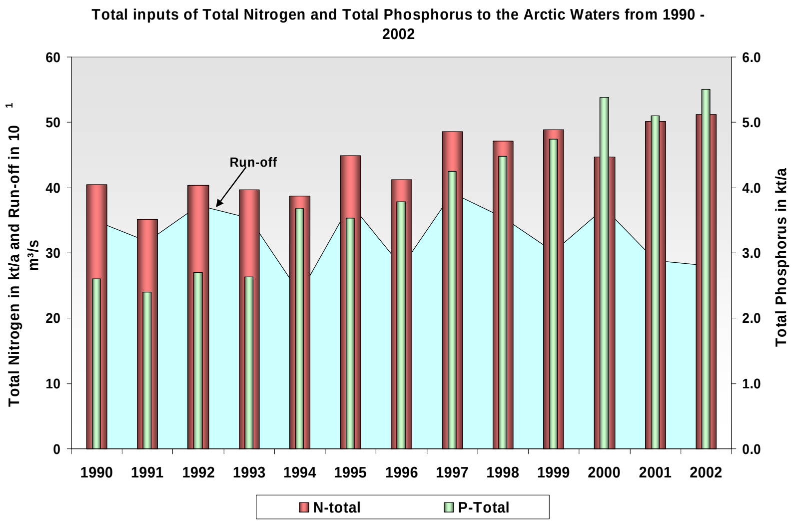
The detailed assessments of inputs for each of the three OSPAR regions, using the RTrend software and applying the A0 flow-adjustment methodology, where possible, are available in Annexes 1 – 12 to this report which are published in the "Assessment and Monitoring" section of the OSPAR website (http://www.ospar.org). The basic information and results from each of these assessments are contained in sections 7.1 – 7.3 of this report. It should be noted that in the three tables of basic data provided in this section, the flow rate (Q) is a sum of riverine and direct components.

7.1 Region I: Arctic Waters (Annex 1)

Table 1A below shows the basic inputs and flow data upon which the assessment of the inputs to Arctic Waters is based; these are Norwegian data only. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. In absolute terms, inputs to this region are low. Annual riverine flows for Region I show a small random variation around the mean annual flow and have a fairly balanced distribution over the period of assessment.

Table 1A: Basic data on inputs and flows to the Arctic Waters

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	8	1.4	0.11	0.11	1.8	32	1.2	10.6	0.23	63	30121
1991	9	1.5	0.11	0.07	1.6	26	0.9	4.6	0.21	49	27444
1992	9	1.5	0.05	0.02	0.6	31	1.2	2.8	0.26	15	32206
1993	10	1.7	0.08	0.02	0.6	29	0.9	2.8	0.13	12	30512
1994	12	2.8	0.10	0.02	0.8	27	0.9	2.5	0.13	32	20562
1995	14	2.4	0.10	0.02	0.9	31	1.1	3.1	0.23	28	32460
1996	16	2.8	0.10	0.02	0.9	26	1.0	1.2	0.22	25	24039
1997	18	3.2	0.10	0.02	0.9	30	1.1	1.9	0.23	24	33833
1998	18	3.4	0.10	0.02	0.9	29	1.1	1.3	0.28	22	30586
1999	18	3.3	0.10	0.01	1.3	31	1.4	0.6	0.60	10	26063
2000	20	3.9	0.17	0.01	5.2	25	1.5	0.4	0.90	6	31849
2001	18	3.5	0.10	0.01	3.8	32	1.6	1.1	0.40	3	24875
2002	22	4.3	0.05	0.01	1.6	29	1.2	1.0	0.62	10	24262



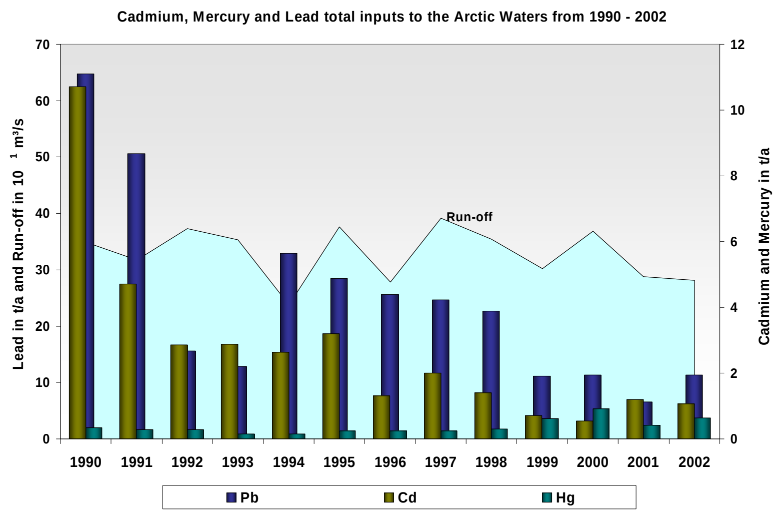


Table 1B provides the results of the assessment for the Arctic Waters following the application of the RTrend software and guidance. For five of the 15 assessed determinand-load types significant downward trends were detected for: the riverine inputs and total inputs of Cadmium and Lead, and the direct discharges of Mercury. The total inputs as well as the direct discharges of total Nitrogen and total Phosphorus showed a significant upward trend. The significant upward trend for direct discharges of Nitrogen and Phosphorus in the period 1990 – 2002 is due to increased fish farming production. As the proportion of direct discharges is high compared to riverine inputs, the total inputs of Nitrogen and Phosphorus also show an increase in the period of assessment.

The trend analysis is questionable for direct discharges of Lead since the values from Norway in the Norwegian Sea in 2000 and 2001 are quite high compared to the other years. The increase in Mercury inputs in the last years of the assessment period is due to a new analytical method introduced in 1999.

Table 1B: Trend assessment of inputs to Arctic Waters for the period 1990 – 2002

Determinand	Assessed Load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend %	Comment
Total Nitrogen	Direct	-	Monotonic non-linear	LOESS level[9]	**U 165% Significant**	
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 3% Not significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**U 32% Significant**	
Total Phosphorus	Direct	-	Monotonic non-linear	LOESS level	**U 230% Significant**	
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**U 30% Not significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**U 135% Significant**	
Cadmium	Direct	-	Non-monotonic	LOESS level	**D 12% Not significant**	need to evaluate the reasons for the disproportionately high discharge in 2000
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 90% Significant**	
	Aggregated	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 89% Significant**	
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 91% Significant**	
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**U 180% Significant**	
	Aggregated	Adjustment should not be applied	Monotonic non-linear	LOESS level	**U 105% Not significant**	
Lead	Direct	-	Non-monotonic	LOESS level	**U 100% Not significant**	need to evaluate the reasons for the disproportionately high discharges in 2000 and 2001
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 93% Significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 87% Significant**	

Key: U = upward; D = downward

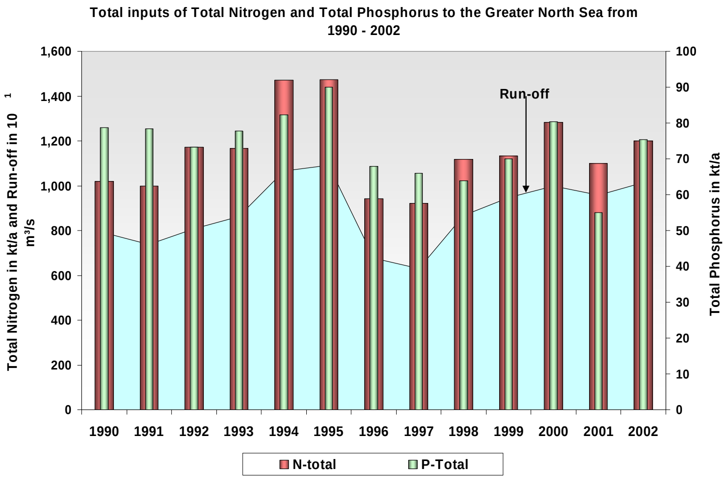
[9] The LOESS level describes a trend assessment technique based on the underlying non-linear trend.

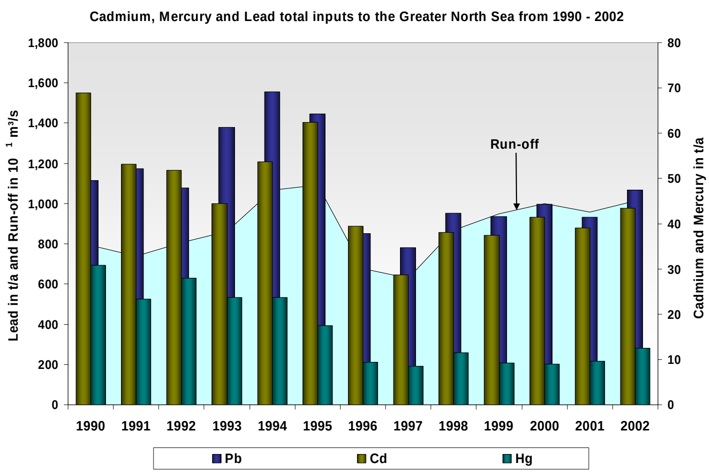
7.2 Region II: Greater North Sea (Annex 2)

Table 2A below shows the basic inputs and flow data upon which the assessment of the inputs to the Greater North Sea is based. The charts below show the total inputs of the five substances assessed and the riverine flows. Inputs to this region amount to 65 – 80% of the total inputs to Regions I, II and III, and are three times higher than those to Region III. Annual riverine flows for Region II show a wide variation around the mean annual flow. Flows in the first three years and in the period 1996 – 1997 were lower than the average for the assessed time period 1990 – 2002; flows in the last four years and in the period 1994 – 1995 were above this average. These factors indicate the desirability of flow-adjustment in order to reliably determine underlying trends in riverine inputs.

Table 2A: Basic data on inputs and flows to the Greater North Sea

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	112	17	9.3	2.2	135	907	61	59.6	28.7	982	674704
1991	103	18	7.2	2.1	135	895	61	45.9	21.2	1039	627450
1992	101	15	3.6	0.8	116	1069	58	48.2	27.2	962	688280
1993	99	14	3.2	0.7	70	1067	64	41.1	23.0	1308	736214
1994	90	15	2.7	0.6	63	1380	67	51.0	23.1	1493	913026
1995	91	15	2.8	0.6	62	1382	76	59.6	16.8	1384	935998
1996	85	14	2.9	0.5	59	856	54	36.6	8.9	792	583489
1997	85	14	3.0	0.5	53	836	52	25.6	8.0	727	540012
1998	81	14	2.7	0.6	44	1037	50	35.3	10.9	907	748612
1999	81	15	2.1	0.5	51	1053	55	35.3	8.7	885	817648
2000	78	14	2.7	0.4	48	1203	67	38.7	8.7	948	862503
2001	79	12	1.4	0.7	45	1021	43	37.7	8.9	887	827042
2002	79	11	1.0	0.5	28	1122	64	42.4	12.0	1040	874426





For Region II, there were strong reductions in direct discharges of heavy metals, and reductions of about 30% in nutrients, but less distinct reductions in riverine inputs of Lead and Cadmium, and no reductions in riverine inputs of nutrients. Generally, direct discharges were the smaller, and progressively diminishing, component of overall inputs for each substance.

Table 2B provides the results of the assessment following the application of the RTrend software and guidance. For 12 of the 15 assessed determinand-load types significant downward trends were detected. The adjustment of the riverine loads was necessary for all substances in order to detect downward trends. For total Phosphorus no flow-adjustment was performed although necessary because the only available method for yearly loads (A0) was not applicable. No significant trend with respect to the riverine inputs or the total inputs of total Phosphorus could, therefore, be detected. The trend assessment will have to be done on the basis of more frequent data than the yearly loads or longer time series. For riverine inputs of total Nitrogen no significant downward trend could be detected by using adjustment. For riverine inputs of Mercury, downward trends could be detected without adjustment.

Table 2B: Trend assessment of inputs to the Greater North Sea for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comment
Total Nitrogen	Direct	-	Monotonic non-linear	LOESS level[9]	**D 29% Significant**	
	Riverine	A0[8]	Non-monotonic	LOESS level	**D 10% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 12% Significant**	
Total Phosphorus	Direct	-	Non-monotonic	LOESS level	**D 33% Significant**	
	Riverine	Adjustment is necessary, but A0 is not applicable	Non-monotonic	LOESS level	**D [1%] Not significant**	
	Aggregated	Adjustment for riverine loads is necessary, but A0 is not applicable	Non-monotonic	LOESS level	**D [8%] Not significant**	
Cadmium	Direct	-	Monotonic non-linear	LOESS level	**D 86% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 44% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 49% Significant**	
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 75% Significant**	
	Riverine	A0	Monotonic non-linear	LOESS level	**D 73% Significant**	
	Aggregated	A0 for riverine load	Monotonic non-linear	LOESS level	**D 73% Significant**	
Lead	Direct	-	Monotonic non-linear	LOESS level	**D 75% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 27% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 33% Significant**	

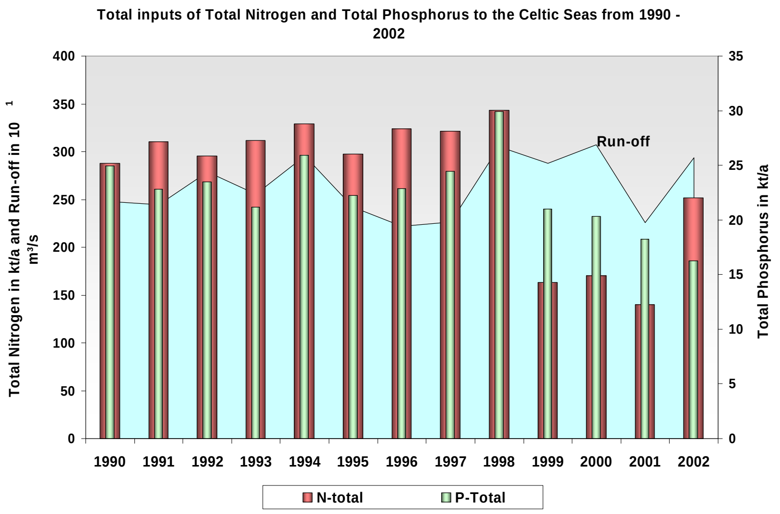
Key: U = upward; D = downward; [%] – indicates that the trend is questionable as it is provisional because flow adjustment was required but could not be done.

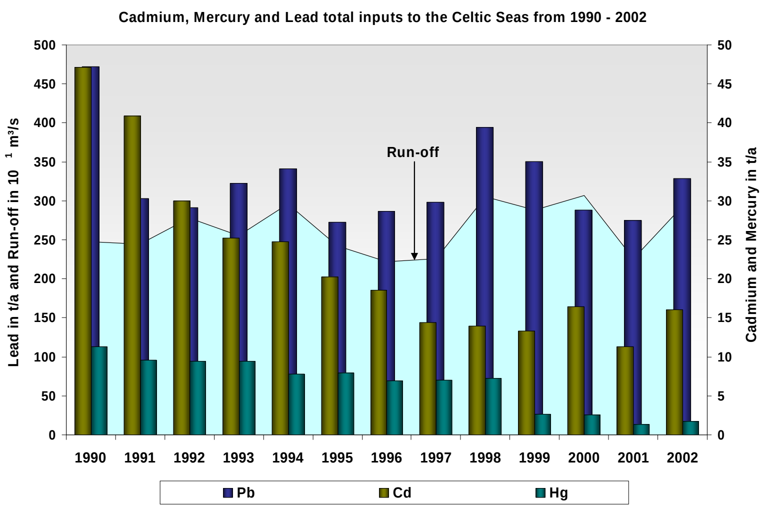
7.3 Region III: Celtic Seas (Annex 3)

Table 3A below shows the basic inputs and flow data upon which the assessment of the inputs to the Celtic Seas is based. Inputs to this Region amount to 5% of the total inputs to Regions I, II and III. The charts below show the total (riverine and direct) inputs of the five substances assessed and the riverine flows. In absolute terms, inputs to this Region are about one third of those to Region II. Annual riverine flows for Region III show a limited variation around the mean, with flows for 1992, 1994 and four of the last five years being above the mean of the assessed time period 1990 – 2002, and with flows for the first two years, for 1995 – 1997 and for 2001 being below the mean.

Table 3A: Basic data on inputs and flows to the Celtic Seas

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	45	12.0	26.9	3.2	72	243	12.9	20.2	8.0	400	211560
1991	41	12.8	15.8	1.8	38	269	10.0	25.1	7.7	264	208728
1992	53	12.2	12.4	1.8	57	243	11.3	17.7	7.6	234	234958
1993	45	7.0	9.3	1.0	100	267	14.2	16.0	8.4	223	217464
1994	48	9.5	6.7	0.7	83	281	16.4	18.0	7.1	257	251862
1995	43	8.4	6.3	0.5	72	254	13.8	13.9	7.4	200	207191
1996	38	8.6	7.1	0.5	64	286	14.3	11.4	6.5	223	191585
1997	40	9.7	5.6	0.4	64	281	14.8	8.9	6.6	234	195123
1998	46	10.1	3.5	0.5	75	298	19.8	10.4	6.7	320	263309
1999	38	8.2	4.5	0.5	60	126	12.8	8.8	2.2	290	248527
2000	38	7.6	2.5	0.5	48	132	12.7	14.0	2.1	240	264971
2001	35	7.3	2.0	0.4	34	105	10.9	9.3	1.0	241	195012
2002	32	5.9	2.9	0.4	28	220	10.4	13.1	1.3	300	253441





The results of the assessment for Regions III are given in Table 3B. Generally, direct discharges were the smaller, and progressively diminishing, component of overall inputs for each substance. The results of the assessment, which are given in Table 3B, were less conclusive than they could have been due to gaps in data – see below.

For four of the assessed 15 determinand-load types acceptable downward trends were detected for: riverine loads and total inputs of Cadmium as well as total inputs of Phosphorus into the Celtic Seas. The significant reductions detected for riverine loads of total Nitrogen are questionable, since the relevant data from Ireland for all 3 sub-regions (around 150 kt/a) is missing for 1999 – 2001. Significant reductions of Mercury are also not accepted since data for all direct discharges of Mercury is missing, and data from Ireland for all riverine loads of Mercury concerning all 3 sub-regions (around 5 t/a) is missing from 1999 onwards.

This assessment could be more conclusive if identified anomalies had been addressed and time series for all sub-regions and countries had been completed. (Refer to the detailed assessment report for details).

Table 3B: Trend assessment of inputs to the Celtic Seas for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Total Nitrogen	Direct	-	Non-monotonic	LOESS level[9]	**D 29% Significant Not accepted**	Need to check and complete data from Ireland
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 43% Not significant**	Need to incorporate missing data from Ireland for 1999-2001
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 40% Significant Not accepted**	Reduction is questionable due to missing data from Ireland for 1999-2001
Total Phosphorus	Direct	-	Non-monotonic	LOESS level	**D 52% Significant Not accepted**	Need to check and complete data from Ireland
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 11% Not significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 33% Significant**	
Cadmium	Direct	-	Monotonic non-linear	LOESS level	**D 91% Significant Not accepted**	Need to check and complete data from Ireland
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 45% Significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 68% Significant**	
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 86% Significant Not accepted**	Need to incorporate all data from Ireland
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 95% Significant Not accepted**	Reduction is questionable due to missing data from Ireland for 1999-2002
	Aggregated	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 93% Significant Not accepted**	Reduction is questionable due to missing direct discharges and riverine inputs from Ireland
Lead	Direct	-	Non-monotonic	LOESS level	**D 51% Not significant**	Data have to be checked and completed by Ireland Anomaly identified in inputs from ICES Zone E28
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 21% Not significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 25% Not significant**	

Key: U = upward; D = downward

8. Results of the assessments of inputs at sub-regional level of the Greater North Sea

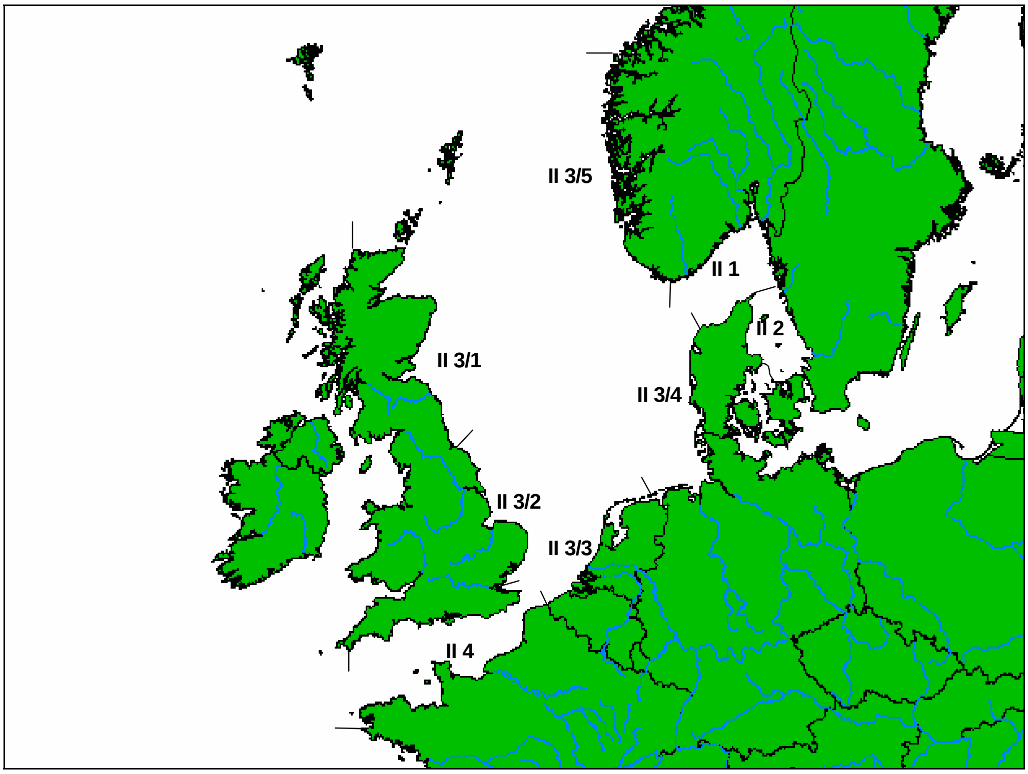


Figure 2: Map of the Greater North Sea and its sub-regions / units of assessment

Sub-region of the Greater North Sea	Sub-regions / units of assessment
North Sea Main Body	**II 3**
North-West North Sea - (UK East Coast (North))	**II 3/1**
South-West North Sea - (UK East Coast (South))	**II 3/2**
South-East North Sea - (Belgian and Dutch Coasts)	**II 3/3**
East North Sea - (German and West Danish Coasts)	**II 3/4**
North-East North Sea – (Norwegian West Coast)	**II 3/5**
Skagerrak	**II 1**
Kattegat	**II 2**
Channel	**II 4**

There are four traditional subdivisions of the Greater North Sea that have been used for earlier assessment of inputs: the North Sea Main Body; the Skagerrak; the Kattegat and the Channel. The North Sea Main Body is by far the largest of these, and it receives the major part (about 80%) of the inputs in the region. In order to facilitate assessment on a comparable geographical scale to the other three traditional subdivisions, the North Sea Main Body has been subdivided into five units of assessment as shown above.

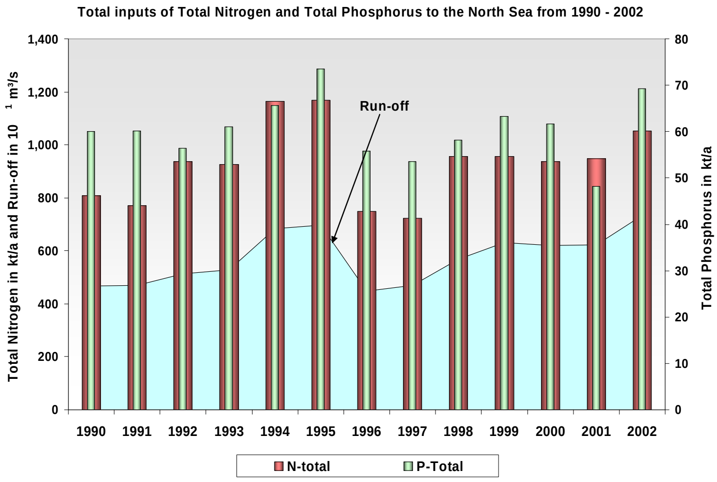
The detailed assessments of inputs for each of the nine units of assessment in the Greater North Sea, using RTrend and applying the A0 flow adjustment methodology where this was possible, are separately published on the OSPAR website. The basic information and results from each of these assessments are contained in sections 8.1-8.9 of this report. It should be noted that, of the nine tables of basic data provided in this section, only in Tables 4A, 10A, 11A and 12A the flow rate (Q) is a sum of riverine and direct components.. In the other five tables, only riverine flows are given.

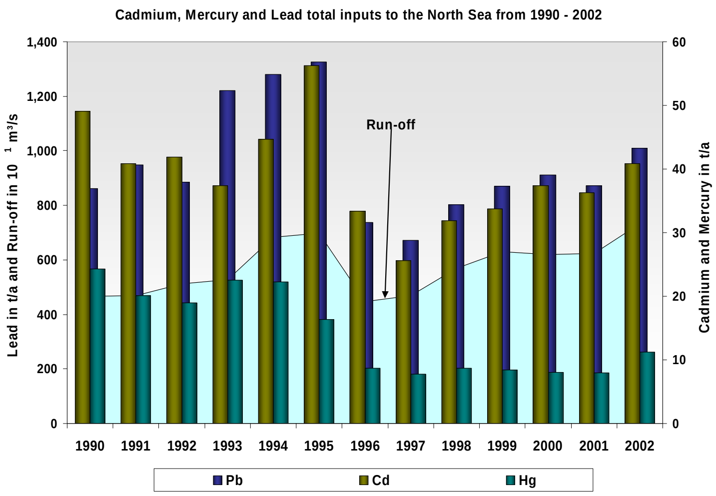
8.1 Region II 3: North Sea Main Body (Annex 4)

Table 4A below shows the basic inputs and flow data upon which the assessment of the inputs to the North Sea Main Body is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. In absolute terms, inputs to this sub-region represent about 80% of the inputs to the whole of Region II. Annual riverine flows show a wide variation around the mean annual flow. Flows in the first four years and in 1994/1995 were lower than the average for the assessed time period 1990 – 2002; flows in the last five years were about as well as above the average, thus indicating the desirability of flow-adjustment in order to reliably determine underlying trends in riverine inputs.

Table 4A: Basic data on inputs and flows to the North Sea Main Body

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q 10³m³/d
1990	88	13.6	6.2	1.8	109	720	46	43	22.5	753	397572
1991	78	14.4	5.2	1.9	115	692	46	36	18.3	833	396893
1992	77	12.2	3.3	0.7	104	861	44	39	18.3	782	436796
1993	75	10.9	3.0	0.6	62	850	50	34	22.0	1160	449896
1994	67	12.9	2.5	0.6	57	1097	53	42	21.7	1223	583854
1995	69	12.2	2.7	0.5	54	1100	61	54	15.8	1272	595972
1996	63	11.8	2.7	0.4	51	687	44	31	8.2	686	385142
1997	65	11.8	2.4	0.4	47	659	42	23	7.3	624	401930
1998	63	12.1	2.5	0.5	40	894	46	29	8.2	763	490618
1999	63	13.2	1.7	0.4	44	893	50	32	7.9	826	543915
2000	61	11.6	2.4	0.3	42	875	50	35	7.7	871	534672
2001	59	10.2	1.1	0.6	38	889	38	35	7.3	834	537510
2002	61	9.4	0.9	0.4	24	991	60	40	10.8	986	632882





For the North Sea Main Body, there were strong reductions in direct discharges of heavy metals and riverine inputs of Mercury as well as reductions of about 30% in nutrients. There are less distinct patterns of change in riverine inputs of all other substances. Generally, direct inputs were the smaller, and progressively diminishing, component of overall inputs for each substance.

The results of the assessment of the North Sea Main Body are provided in Table 4B. Significant downward trends in direct discharges and riverine inputs are indicated for all substances; only for the riverine inputs of Lead the reduction was not confirmed as being significant. Flow adjustment of the riverine inputs was necessary and applied for all substances. This helped counter the influence of variation in flow which was significantly skewed over the period of assessment.

Table 4B: Trend assessment of inputs to the North Sea for the period 1990-2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comment
Total Nitrogen	Direct	-	Monotonic non-linear	LOESS level[9]	**D 30% Significant**	
	Riverine	A0[8]	Non-monotonic	LOESS level	**D 13% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 14% Significant**	
Total Phosphorus	Direct	-	Non-monotonic	LOESS level	**D 29% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 28% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 28% Significant**	
Cadmium	Direct	-	Monotonic non-linear	LOESS level	**D 82% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 36% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 41% Significant**	
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 74% Significant**	
	Riverine	A0	Monotonic non-linear	LOESS level	**D 73% Significant**	
	Aggregated	A0 for riverine load	Monotonic non-linear	LOESS level	**D 73% Significant**	
Lead	Direct	-	Monotonic non-linear	LOESS level	**D 75% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 20% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 26% Significant**	

Key: U = upward; D = downward

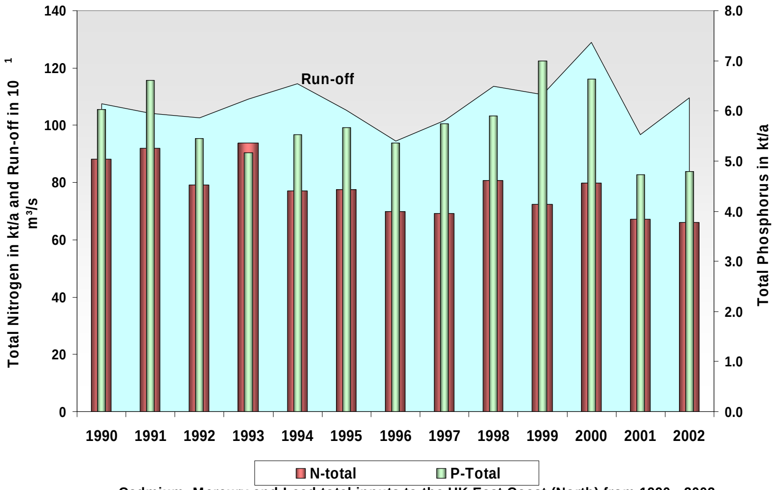
8.2 Region II 3/1: North-West North Sea (UK East Coast (North)) (Annex 5)

Table 5A below shows the basic inputs and flow data upon which the assessment of the inputs to the North-West North Sea is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Generally, inputs to this sub-region are low, representing about 15% of the inputs to the whole area of Region II. Flows for this region have shown a small variation around the mean with no skew over the period of assessment.

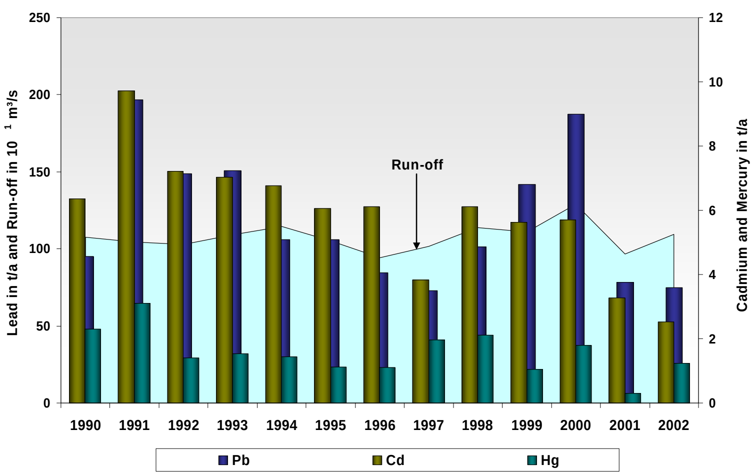
Table 5A: Basic data on inputs and flows to the North-West North Sea (UK East Coast (North))

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	51	4.5	2.28	0.79	41	37	1.5	4.1	1.51	54	92960
1991	39	5.1	3.04	1.41	60	53	1.5	6.7	1.70	137	90010
1992	36	4.0	1.18	0.17	45	43	1.5	6.0	1.24	104	88720
1993	37	3.7	1.48	0.13	26	57	1.5	5.6	1.41	124	94350
1994	27	3.9	0.72	0.18	24	50	1.6	6.0	1.26	82	99040
1995	28	4.1	0.81	0.14	25	50	1.6	5.2	0.99	81	90960
1996	23	3.6	1.00	0.12	27	47	1.7	5.1	0.99	58	81540
1997	23	4.0	0.78	0.14	21	46	1.8	3.1	1.82	52	87810
1998	20	3.7	0.98	0.13	18	61	2.2	5.1	1.98	83	98240
1999	20	4.0	0.23	0.12	15	52	3.0	5.4	0.92	126	95720
2000	19	4.1	0.47	0.09	21	61	2.6	5.2	1.70	166	111390
2001	17	2.8	0.29	0.1	15	50	1.9	3.0	0.19	63	83520
2002	18	3.2	0.16	0.15	6.0	48	1.6	2.4	1.08	69	94667

Total inputs of Total Nitrogen and Total Phosphorus to the UK East Coast (North) from 1990 - 2002



Cadmium, Mercury and Lead total inputs to the UK East Coast (North) from 1990 - 2002



The results of the assessment of the North-West North Sea are provided in Table 5B. There were significant reductions in direct discharges for all substances assessed and for the riverine inputs of Cadmium. For the riverine inputs of Mercury, Lead and total Nitrogen, the detected downward trends are not significant. Riverine inputs of total Phosphorus showed a large and significant upward trend which could not be explained and should be investigated.

Table 5B: Trend assessment of inputs to the North-West North Sea for the period 1990-2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Cadmium	Direct	-	Monotonic	LOESS level[9]	**D 95% Significant**	
	Riverine	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope[10]	**D 35% Significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 51% Significant**	
Mercury	Direct	-	Monotonic	LOESS level	**D 88% Significant**	
	Riverine	A0[8]	Non-monotonic	Mann-Kendall and Theil slope	**D 42% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**D 55% Significant**	
Lead	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 76% Significant**	
	Riverine	A0	Non-monotonic	Mann-Kendall and Theil slope	**D 18% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**D 37% Not significant**	
Total Nitrogen	Direct	-	Monotonic	LOESS level	**D 64% Significant**	
	Riverine	A0	Monotonic	LOESS level	**U 15% Not significant**	
	Aggregated	A0 for riverine load	Linear	LOESS linear	**D 26% Significant**	
Total Phosphorus	Direct		Monotonic	LOESS level	**D 34% Significant**	
	Riverine	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**U 42% Significant**	need to investigate cause of increase
	Aggregated	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 7% Not significant**	

Key: U = upward; D = downward; [%] = indicates that the trend is questionable as it is provisional because flow adjustment was required but could not be done.

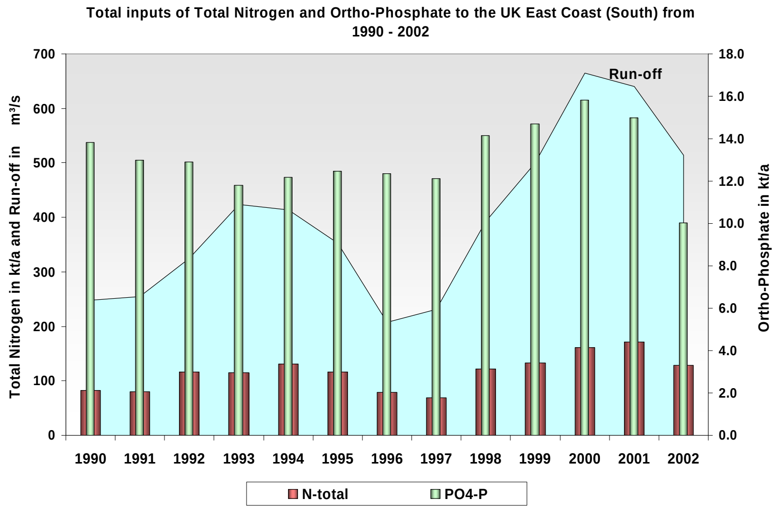
[10] The "Mann-Kendall" is a non-parametric trend assessment technique for detecting monotonic trends.

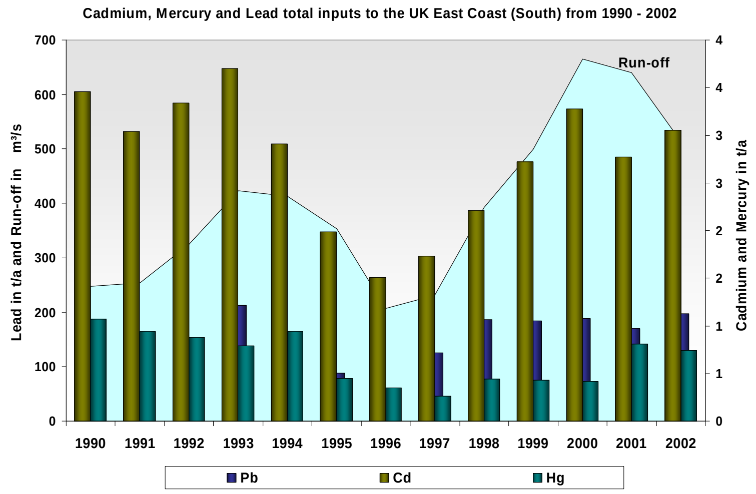
8.3 Region II 3/2: South-West North Sea (UK East Coast (South)) (Annex 6)

Table 6A below shows the basic inputs and flow data upon which the assessment of the inputs to the South-West North Sea is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Generally, inputs to this sub-region are significant, representing about 5% of the inputs to the whole area of Region II. Over the period of assessment, annual riverine flows show a wide variation around the mean annual flow, with flows for the last four years and 1993/1994 being above the mean for the period 1990 – 2002, and with flows for the first three years and 1996/1997 being below the mean. This indicates the desirability of flow-adjustment in order to reliably determine underlying trends in riverine inputs.

Table 6A: Basic data on inputs and flows to the South-West North Sea (UK East Coast (South))

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	PO_4-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	PO_4-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	23	6.7	1.76	0.2	39	60	7.1	1.7	0.87	56	21409
1991	19	6.4	1.01	0.11	37	61	6.6	2.0	0.83	106	21962
1992	23	5.6	0.79	0.2	35	93	7.3	2.6	0.68	93	28050
1993	19	4.5	0.49	0.14	18	97	7.4	3.2	0.65	194	36595
1994	19	4.8	0.37	0.12	23	111	7.3	2.5	0.82	107	35729
1995	19	4.7	0.42	0.11	18	98	7.8	1.6	0.34	71	30507
1996	19	5.1	0.28	0.08	16	60	7.2	1.2	0.27	43	17945
1997	19	4.9	0.23	0.08	16	49	7.2	1.5	0.18	109	19972
1998	19	5.3	0.22	0.12	14	103	8.9	2.0	0.32	173	33904
1999	20	4.6	0.23	0.12	17	113	10.1	2.5	0.31	167	43174
2000	18	4.4	0.32	0.09	14	143	11.5	3.0	0.33	175	57481
2001	19	4.5	0.22	0.29	14	152	10.5	2.6	0.52	156	55313
2002	21	3.1	0.25	0.13	8.6	108	7.0	2.8	0.61	189	44385





The results of the assessment of the South-West North Sea are provided in Table 6B. The assessment for this part of the North Sea Main Body indicates significant downward trends in direct discharges of total Phosphorus, Cadmium and Lead and in riverine inputs of Cadmium and Mercury.

Riverine and total inputs of total Phosphorus show a significant upward trend that is not accepted. The reason is that flow adjustment was necessary but could not be performed since the only available method for yearly loads (A0) was not applicable. Therefore, no significant upward trend with respect to the riverine inputs or the total inputs could be detected. The search for a possible trend will have to be done on the basis of more frequent data than the yearly loads or longer time series.

Table 6B: Trend assessment of inputs to the South-West North Sea for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Cadmium	Direct	-	Monotonic	LOESS level[9]	**D 83% Significant**	
	Riverine	A0[8]	Non-monotonic	Mann-Kendall and Theil slope[10]	**D 44% Significant**	
	Aggregated	A0 for riverine load	Monotonic	LOESS level	**D 55% Significant**	
Mercury	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 15% Not significant**	
	Riverine	A0	Monotonic	LOESS level	**D 73% Significant**	
	Aggregated	A0 for riverine load	Monotonic	LOESS level	**D 64% Significant**	
Lead	Direct	-	Monotonic	LOESS level	**D 74% Significant**	
	Riverine	A0	Non-monotonic	Mann-Kendall and Theil slope	**U 6% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**D 13% Not significant**	
Total Nitrogen	Direct	-	Monotonic	LOESS level	**D 8% Not significant**	
	Riverine	A0	Monotonic	LOESS level	**D 11% Not significant**	
	Aggregated	A0 for riverine load	Monotonic	LOESS level	**D 11% Not significant**	
Total Phosphorus	Direct	-	Monotonic	LOESS level	**D 46% Significant**	
	Riverine	Adjustment is necessary, but A0 is not applicable	Non-monotonic	Mann-Kendall and Theil slope	**U [49%] Significant**	
	Aggregated	Adjustment for riverine loads is necessary, but A0 is not applicable	Non-monotonic	Mann-Kendall and Theil slope	**U [10%] Not significant**	

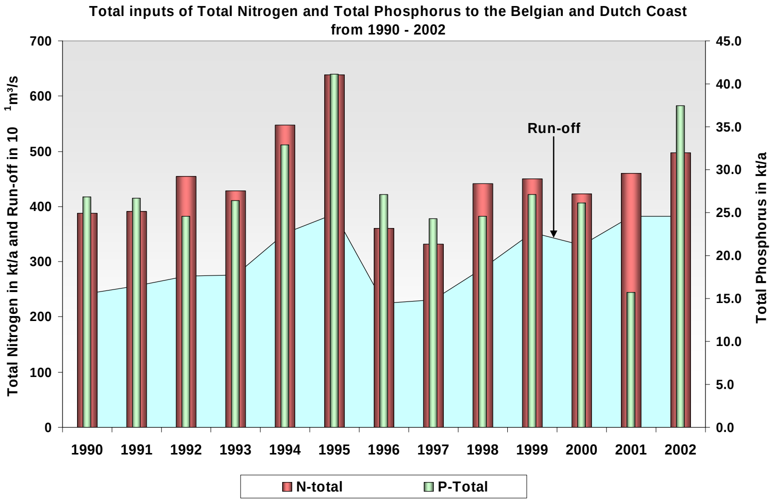
Key: U = upward; D = downward; [%] – indicates that the trend is questionable as it is provisional because flow adjustment was required but could not be done.

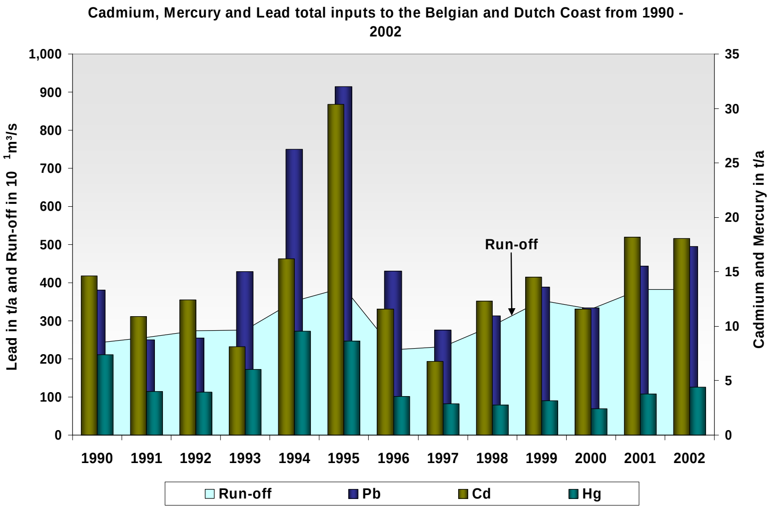
8.4 Region II 3/3: South-East North Sea (Belgian and Dutch Coast) (Annex 7)

Table 7A below shows the basic inputs and flow data upon which the assessment of the inputs to the South-East North Sea (Belgian and Dutch Coast) is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Generally, inputs to this sub-region are substantial, representing about 40% of the inputs to the whole area of Region II. Over the period of assessment, annual riverine flows show a wide variation around the mean annual flow, with flows for the last four years and in 1994/1995 above the mean, and with flows for the first four years and from 1996 – 1998 below the mean. This indicates that flow-adjustment is desirable in order to reliably determine underlying trends in riverine inputs.

Table 7A: Basic data on inputs and flows to the South-East North Sea (Belgian and Dutch Coast)

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	5.2	1.2	0.8	0.2	14	383	25.6	13.8	7.2	367	209261
1991	5.9	1.0	0.3	0.1	3.4	385	25.7	10.6	3.9	247	221897
1992	6.4	1.1	0.1	0.06	1.9	448	23.5	12.3	3.9	253	236483
1993	6.3	1.1	0.1	0.06	1.9	422	25.3	8.0	6	427	238053
1994	6.1	2.2	0.1	0.06	1.9	542	30.7	16.1	9.5	748	303638
1995	7.0	1.1	0.1	0.06	1.8	632	40.0	30.3	8.6	913	334368
1996	6.4	0.8	0.2	0.08	2.9	354	26.3	11.4	3.5	428	193720
1997	6.4	0.6	0.2	0.08	2.9	326	23.7	6.6	2.8	273	200151
1998	6.8	0.6	0.1	0.08	2.4	435	24.0	12.2	2.7	310	248649
1999	6.5	0.5	0.1	0.07	1.5	444	26.6	14.4	3.1	388	304500
2000	6.4	0.4	0.1	0.03	1.1	416	25.7	11.5	2.4	333	285299
2001	6.1	0.4	0.2	0.1	1.8	454	15.3	18.0	3.7	441	330155
2002	6.3	0.5	0.21	0.01	3.1	491	37.0	17.9	4.4	492	330584





The results of the assessment of the South-East North Sea (Belgian and Dutch Coast) are provided in Table 7B. Generally, direct discharges are much smaller than the riverine inputs and not a significant component of overall inputs. The assessment for this part of the North Sea Main Body indicates significant downward trends in direct discharges of Cadmium and total Phosphorus, in riverine inputs of total Phosphorus as well as in riverine inputs and total inputs of total Nitrogen and Mercury. Riverine inputs of total Phosphorus show an upward trend which is, however, not significant.

The direct discharges of total Nitrogen show a significant upward trend. Although the proportion of direct discharges is small compared to the riverine inputs, there is a need to ascertain the cause of the increasing direct discharges. This should help ascertain whether the increases identified are genuine or an anomaly arising from improved reporting or changes in monitoring practices.

Table 7B: Trend assessment of inputs to the South-East North Sea for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Cadmium	Direct	-	Monotonic	LOESS level[9]	**D 67% Significant**	
	Riverine	A0[8]	Non-monotonic	Mann-Kendall and Theil slope[10]	**D 11% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**D 11% Not significant**	
Mercury	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 41% Not significant**	
	Riverine	A0	Non-monotonic	Mann-Kendall and Theil slope	**D 68% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**D 67% Significant**	
Lead	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 40% Not significant**	
	Riverine	A0	Non-monotonic	Mann-Kendall and Theil slope	**D 19% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**D 19% Not significant**	
Total Nitrogen	Direct	-	Monotonic	LOESS level	**U 13% Significant**	
	Riverine	A0	Monotonic	LOESS level	**D 23% Significant**	
	Aggregated	A0 for riverine load	Monotonic	LOESS level	**D 22% Significant**	
Total Phosphorus	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 72% Significant**	
	Riverine	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**U 2% Not significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 3% Not significant**	

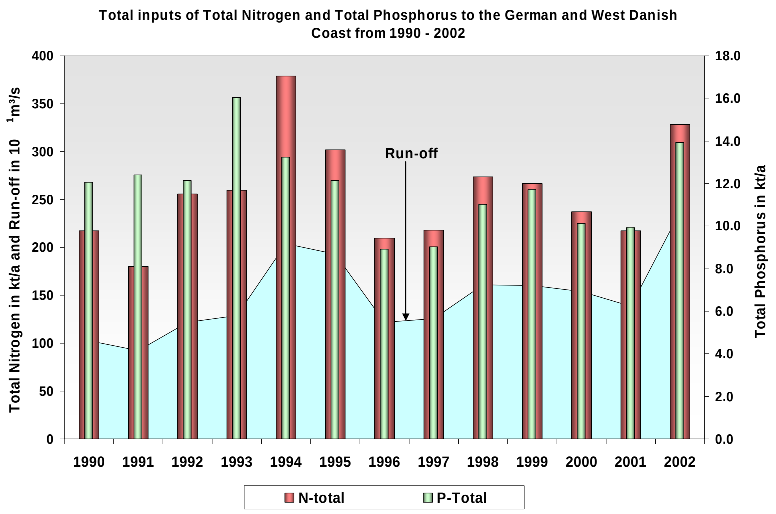
Key: U = upward; D = downward

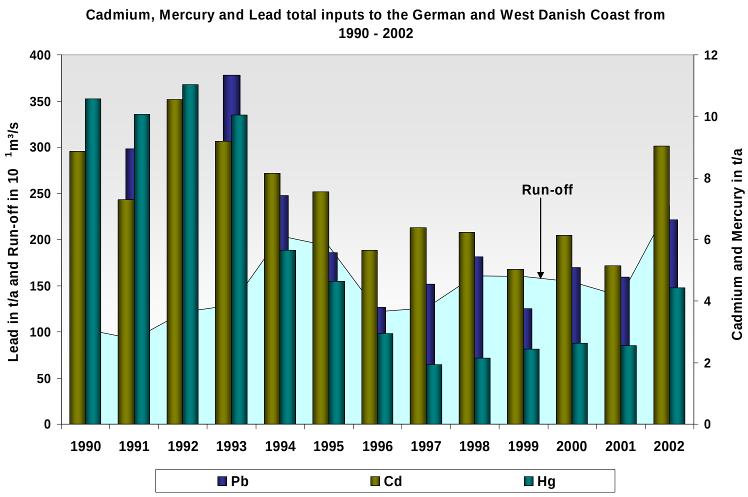
8.5 Region II 3/4: East North Sea (German and West Danish Coasts) (Annex 8)

Table 8A below shows the basic inputs and flow data upon which the assessment of the inputs to the East North Sea (German and West Danish Coasts) is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Generally, inputs to this sub-region are significant, representing about 20% of the inputs to the whole area of Region II. Annual riverine flows show a wide variation around the mean annual flow and a skewed distribution over the period of assessment, with flows for 1994/1995, 1998 –2000 and the last year above the mean, and with flows for the first four years, 1996/1997 and 2001 below the mean. This indicates that flow adjustment is desirable in order to reliably determine underlying trends in riverine inputs.

Table 8A: Basic data on inputs and flows to the East North Sea (German and West Danish Coasts)

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	2.2	0.5	0.06	0.06	1.2	215	12	8.8	11	215	88609
1991	8.9	0.9	0.09	0.06	3.0	171	12	7.2	10	295	79838
1992	5.6	0.6	0.55	0.03	9.9	250	12	10.0	11	305	105034
1993	4.9	0.5	0.2	0.05	5.1	255	16	9.0	10	373	111395
1994	5.6	0.5	0.14	0.05	1.7	373	13	8.0	5.6	246	176332
1995	5.1	0.5	0.05	0.04	1.5	297	12	7.5	4.6	184	166554
1996	4.6	0.5	0.05	0.04	1.5	205	8.4	5.6	2.9	125	105116
1997	4.7	0.5	0.08	0.04	2.5	213	8.5	6.3	1.9	149	108802
1998	4.5	0.5	0.04	0.04	1.4	269	11	6.2	2.1	180	139048
1999	4.4	2.0	0.03	0.04	1.4	262	9.7	5.0	2.4	124	138366
2000	4.5	0.5	0.04	0.04	1.5	233	9.6	6.1	2.6	168	133019
2001	4.1	0.4	0.05	0.05	1.3	213	9.5	5.1	2.5	158	119776
2002	4.0	0.4	0.04	0.04	1.2	324	14	9.0	4.4	220	204703





The results of the assessment of the East North Sea (German and West Danish Coast) are provided in Table 8B. Generally, direct discharges are much smaller than the riverine inputs and not a significant component of the overall inputs. The assessment for this part of the North Sea Main Body indicates significant downward trends in direct discharges of total Nitrogen, total Phosphorus, Cadmium and Lead, in riverine inputs of total Nitrogen, Cadmium and Lead, and in the total inputs of total Nitrogen, Cadmium and Mercury.

Nearly all data from Denmark are missing for direct discharges as well as riverine inputs of heavy metals. The established trends, therefore, need to be checked and evaluated following the incorporation of the missing data.

For total Phosphorus and Cadmium, flow-adjustment was needed but could not be performed since the only available method for yearly loads (A0) was not applicable. Therefore, no significant downward trend with respect to their riverine inputs or their total inputs could be detected. The search for a possible trend will have to be done on the basis of more frequent data than the yearly loads or longer time series.

Table 8B: Trend assessment of inputs to the East North Sea for the period 1990 – 2002

Determinand	Assessed lad type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Cadmium	Direct	-	Non-monotonic	Mann-Kendall and Theil slope[10]	**D 79% Significant**	Missing data from DK
	Riverine	Adjustment is necessary, but A0[8] is not applicable	Non-monotonic	Mann-Kendall and Theil slope	**D [43%] Significant**	Data from DK only for 1990, 2000, 2001
	Aggregated	Adjustment for riverine loads is necessary, but A0 is not applicable	Non-monotonic	Mann-Kendall and Theil slope	**D [43%] Significant**	
Mercury	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 28% Not significant**	Missing data from DK
	Riverine	Adjustment should not be applied	Monotonic	LOESS level[9]	**D 68% Significant**	Data from DK only for 1990, 2000, 2001
	Aggregated	Adjustment should not be applied	Monotonic	LOESS level	**D 68% Significant**	Data gaps in 1998 not material
Lead	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 43% Significant**	Missing data from DK
	Riverine	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 51% Not significant**	Data from DK only for 1990, 2000, 2001
	Aggregated	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 51% Not significant**	
Total Nitrogen	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 31% Significant**	
	Riverine	A0	Linear	LOESS linear	**D 30% Significant**	
	Aggregated	A0 for riverine load	Linear	LOESS linear	**D 30% Significant**	
Total Phosphorus	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 9% Significant**	
	Riverine	Adjustment is necessary, but A0 is not applicable	Non-monotonic	Mann-Kendall and Theil slope	**D [18%] Not significant**	
	Aggregated	Adjustment for riverine loads is necessary, but A0 is not applicable	Non-monotonic	Mann-Kendall and Theil slope	**D [17%] Not significant**	

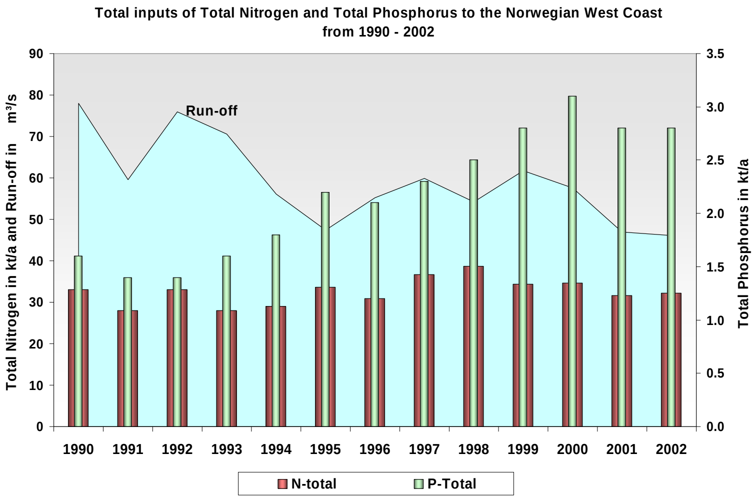
Key: U = upward; D = downward; [%] – indicates that the trend is questionable as it is provisional because flow adjustment was required but could not be done.

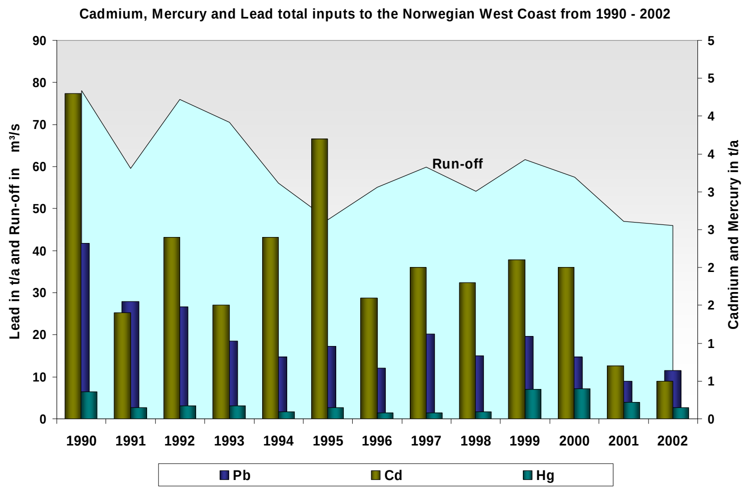
8.6 Region II 3/5: North-East North Sea (Norwegian West Coast (Annex 9)

Table 9A below shows the basic inputs and flow data upon which the assessment of the inputs to the North-East North Sea (Norwegian West Coast) is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Generally, inputs to this sub-region are very low, representing less than 1% of the inputs to the whole area of Region II.

Table 9A: Basic data on inputs and flows to the North-East North Sea (Norwegian West Coast)

	Direct discharges					**Riverine inputs and flows**					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q 10³m³/d
1990	7.0	1.0	0.5	0.3	7.3	26	0.6	3.8	0.06	35	6742
1991	6.0	1.0	0.2	0.1	9.4	22	0.4	1.2	0.05	19	5148
1992	7.0	0.9	0.1	0.1	9.6	26	0.5	2.3	0.07	17	6559
1993	8.0	1.2	0.2	0.1	8.5	20	0.4	1.3	0.07	10	6098
1994	9.0	1.4	1.0	0.04	4.6	20	0.4	1.4	0.05	10	4844
1995	11	1.8	1.0	0.1	6.3	23	0.4	2.7	0.05	11	4090
1996	11	1.7	1.0	0.04	3.2	20	0.4	0.6	0.04	8.9	4766
1997	12	1.8	1.0	0.04	4.2	25	0.5	1.0	0.04	16	5167
1998	13	2.0	1.0	0.04	4.8	26	0.5	0.8	0.05	10	4681
1999	12	2.1	1.0	0.04	7.6	22	0.7	1.1	0.35	12	5329
2000	14	2.3	1.4	0.05	3.7	21	0.8	0.6	0.35	11	4965
2001	13	2.0	0.3	0.01	5.5	19	0.8	0.4	0.21	3.5	4059
2002	12	2.2	0.1	0.01	4.5	20	0.6	0.4	0.14	7.0	3977





The results of the assessment of the North-East North Sea are given in Table 9B. Generally, loads are low which means that any small change in input can have a large influence on the pattern of change. While the results indicate significant downward trends for direct discharges of Mercury and riverine inputs of Cadmium, Lead and total Nitrogen, there are no significant downward trends for the direct discharges and riverine inputs of the other substances. In part this is due to wide variations in the corresponding inputs – see data in Table 9A.

The extremely high increase in riverine inputs of Mercury is attributable to a change of analysis between 1998 and 1999 which caused a step-increase in concentrations (of between 2 and 8 times). The significant high increase in direct discharges of total Nitrogen needs verification. The same is valid for the significant strong increase in direct discharges, riverine loads and total inputs of total Phosphorus. There is a need to ascertain the causes for the increasing inputs over the period of assessment. This should help ascertain whether the increases identified are genuine or an anomaly arising from improved reporting or changes in monitoring practices.

Table 9B: Trend assessment of inputs to the North-East North Sea for the period 1990-2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Cadmium	Direct	-	Non-monotonic	Mann-Kendall and Theil slope[10]	**U 56% Not significant**	
	Riverine	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 86% Significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	Mann-Kendall and Theil slope	**D 60% Not significant**	
Mercury	Direct	-	Monotonic	LOESS level[9]	**D 94% Significant**	
	Riverine	A0[8]	Monotonic	LOESS level	**U 533% Significant**	Reason for the increase: change in analytical method
	Aggregated	A0 for riverine load	Non-monotonic	Mann-Kendall and Theil slope	**U 25% Not significant**	Reason for the increase: change in analytical method for riverine inputs
Lead	Direct	-	Non-monotonic	Mann-Kendall and Theil slope	**D 47% Not significant**	
	Riverine	Adjustment should not be applied	Monotonic	LOESS level	**D 81% Significant**	
	Aggregated	Adjustment should not be applied	Monotonic	LOESS level	**D 72% Significant**	
Total Nitrogen	Direct	-	Monotonic	LOESS level	**U 109% Significant**	need to evaluate the reasons for the increase
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 24% Significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**U [2%] Not significant**	need to evaluate the reasons for the increase
Total Phosphorus	Direct	-	Monotonic	LOESS level	**U 153% Significant**	need to evaluate the reasons for the increase
	Riverine	A0	Monotonic	LOESS level	**U 121% Significant**	need to evaluate the reasons for the increase
	Aggregated	A0 for riverine load	Monotonic	LOESS level	**U 138% Significant**	need to evaluate the reasons for the increase

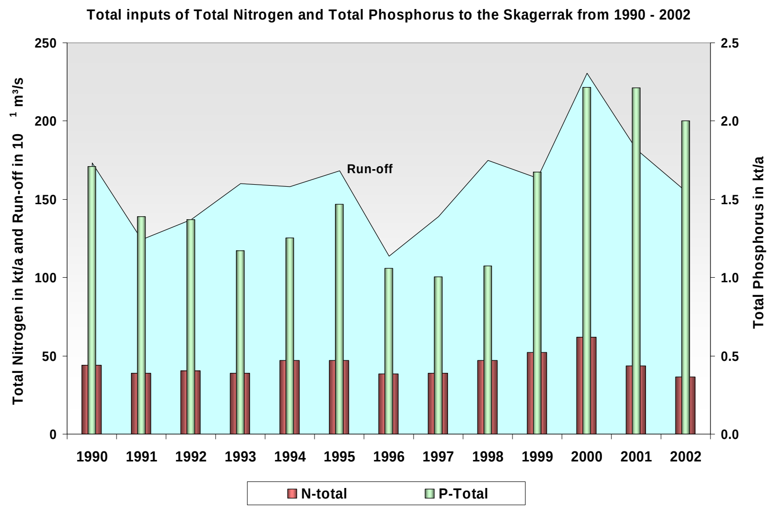
Key: U = upward; D = downward; [%] – indicates that the trend is questionable as it is provisional because flow adjustment was required but could not be done.

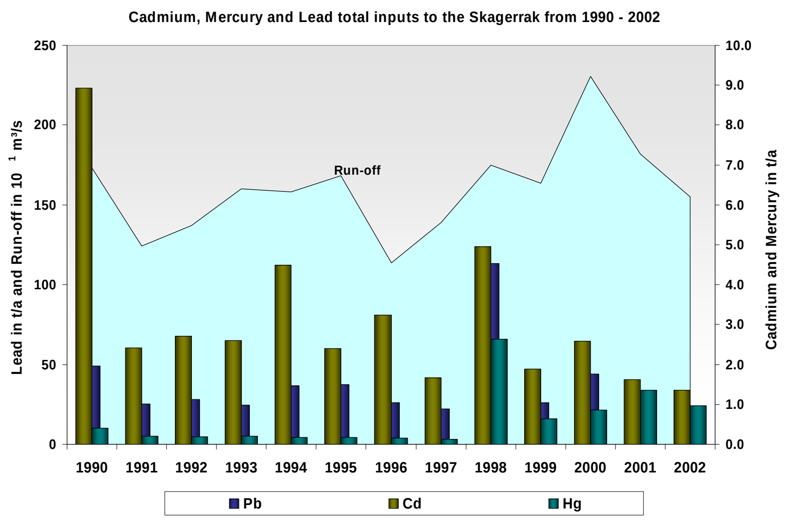
8.7 Region II 1: Skagerrak (Annex 10)

Table 10A below shows the basic inputs and flow data upon which the assessment of the inputs to the Skagerrak is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Inputs to this sub-region represent about 2% of the inputs to the whole area of Region II. Over the period of assessment, annual riverine flows show a wide variation around the mean annual flow. Flows in 2000 were particularly high, thus indicating that flow-adjustment is desirable in order to reliably determine underlying trends in riverine inputs.

Table 10A: Basic data on inputs and flows to the Skagerrak

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	7.9	0.51	0.27	0.20	2.8	36	1.2	8.7	0.20	46.2	149481
1991	8.4	0.56	0.16	0.10	2.4	31	0.8	2.3	0.10	22.7	107139
1992	8.0	0.51	0.10	0.08	1.3	33	0.9	2.6	0.10	26.6	118227
1993	8.8	0.49	0.10	0.09	1.2	30	0.7	2.5	0.10	23.4	138070
1994	8.6	0.39	0.09	0.04	1.0	39	0.9	4.4	0.12	35.5	136671
1995	8.3	0.27	0.09	0.05	0.9	39	1.2	2.3	0.11	36.5	145402
1996	7.9	0.32	0.10	0.05	1.0	31	0.7	3.1	0.10	25.1	98185
1997	7.2	0.32	0.10	0.05	0.7	32	0.7	1.6	0.08	21.6	119945
1998	6.9	0.26	0.10	0.06	0.7	40	0.8	4.9	2.58	112.6	151027
1999	6.4	0.22	0.07	0.02	0.8	46	1.5	1.8	0.62	25.3	141359
2000	6.3	0.22	0.07	0.03	0.8	56	2.0	2.5	0.82	43.3	199015
2001	6.1	0.22	0.07	0.05	0.9	38	2.0	1.6	1.31	17.1	157141
2002	5.4	0.21	0.06	0.03	0.7	31	1.8	1.3	0.93	21.0	133688





Inputs to the Skagerrak are generally low. For seven of the assessed 15 determinand-load types acceptable downward trends were detected. The Cadmium inputs (direct discharges, riverine and total inputs) decreased significantly. Although no data for direct discharges of heavy metals exist from Denmark and the Swedish data for direct discharges of heavy metals are not complete, the direct discharges decreased significantly for all substances. The riverine loads and total inputs of total Phosphorus to the Skagerrak increased significantly over the period 1990 – 2002.

Before the next assessment of inputs to the Skagerrak, the reason for these increases in riverine loads in Norway from 1999 onwards needs to be established to ascertain whether there has been a genuine increase or whether there is some other explanation.

Table 10B provides the results of assessment for the Skagerrak following the application of the RTrend software and guidance. Although the Danish and Swedish heavy metal data (direct discharges, riverine loads and total inputs) are quite small compared to the Norwegian ones, gaps in these time series should be made good before repeating the trend analysis.

Table 10B: Trend assessment of inputs to the Skagerrak for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Total Nitrogen	Direct	-	Monotonic non-linear	LOESS level[9]	**D 32% Significant**	
	Riverine	A0[8]	Non-monotonic	LOESS level	**D 7% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 11% Not significant**	
Total Phosphorus	Direct	-	Non-monotonic	LOESS level	**D 64% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**U 76% Significant**	Recent increases in inputs need investigating
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**U 28% Significant**	Recent increases in inputs need investigating
Cadmium	Direct	-	Monotonic non-linear	LOESS level	**D 73% Significant**	
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 77% Significant**	
	Aggregated	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 77% Significant**	
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 80% Significant**	
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**U 540% Not significant**	Recent increases in inputs need investigating
	Aggregated	Adjustment should not be applied	Monotonic non-linear	LOESS level	**U 220% Not significant**	Recent increases in inputs need investigating
Lead	Direct	-	Monotonic non-linear	LOESS level	**D 69% Significant**	
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**D 51% Not significant**	High input in 1998 needs investigating
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 53% Not significant**	High riverine input in 1998 needs investigating

Key: U = upward; D = downward

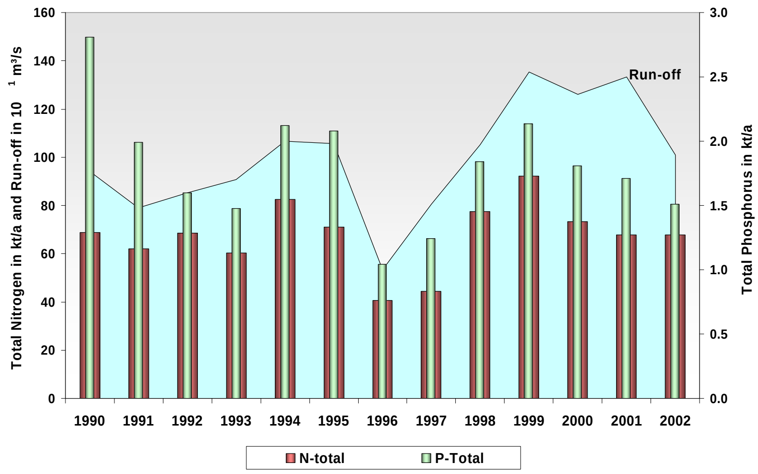
8.8 Region II 2: Kattegat (Annex 11)

Table 11A below shows the basic inputs and flow data upon which the assessment of the inputs to the Kattegat is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. Inputs to this sub-region represent about 10-15% of the inputs to the whole area of Region II. Annual riverine flows show a wide variation around the mean annual flow over the period of assessment. Flows in 1996 were particularly low, thus indicating that flow-adjustment is desirable in order to reliably determine underlying trends in riverine inputs.

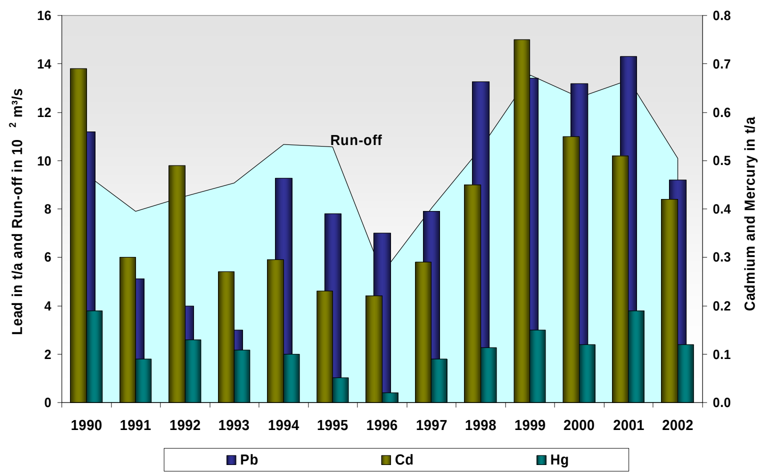
Table 11A: Basic data on inputs and flows to the Kattegat

	Direct discharges					**Riverine inputs and flows**					
Year	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	Tot-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3 m^3/d$
1990	5.3	0.51	0.10	0.10	2.1	64	2.3	0.6	0.09	9.1	80604
1991	5.2	0.39	0.10	0.02	0.9	57	1.6	0.2	0.07	4.2	67560
1992	5.4	0.38	0.09	0.06	0.7	63	1.2	0.4	0.07	3.3	72864
1993	4.6	0.29	0.07	0.04	0.6	56	1.2	0.2	0.07	2.4	77929
1994	4.8	0.32	0.10	0.03	0.6	78	1.8	0.2	0.07	8.7	91564
1995	4.6	0.31	0.03	0.04	0.5	66	1.8	0.2	0.01	7.3	90653
1996	3.9	0.20	0.02	0.02	0.3	37	0.8	0.2	0.00	6.7	45577
1997	3.7	0.20	0.09	0.04	0.6	41	1.0	0.2	0.05	7.3	69070
1998	3.3	0.21	0.05	0.02	0.4	74	1.6	0.4	0.09	12.9	90244
1999	2.8	0.17	0.05	0.02	0.4	89	2.0	0.7	0.13	13.0	116224
2000	2.6	0.18	0.05	0.02	0.4	71	1.6	0.5	0.10	12.8	108383
2001	2.4	0.15	0.05	0.03	0.5	65	1.6	0.5	0.16	13.9	114575
2002	2.8	0.17	0.02	0.02	0.2	65	1.3	0.4	0.10	9.0	86634

Total inputs of Total Nitrogen and Total Phosphorus to the Kattegat from 1990 - 2002



Cadmium, Mercury and Lead total inputs to the Kattegat from 1990 - 2002



The results of the assessment of inputs to the Kattegat are given in Table 11B. The assessment of heavy metals was limited, since all data from Denmark were missing, except for 1990. Additionally, some of these 1990 values were very high compared to Swedish data. Also the Swedish data on heavy metals were not always complete.

Consequently, the results of the current assessment are only reliable for nutrients. While direct inputs of both total Nitrogen and total Phosphorus exhibit significant downward trends (more than 50%) and riverine inputs of total Phosphorus show a significant reduction (44%), the 19% reduction in riverine inputs of total Nitrogen was not significant. Although flows were highly variable and high at the end of the time series, flow adjustment was possible, thus countering the influence of flow on the assessment of underlying trends.

There is a need for more complete data sets before this assessment is repeated.

Table 11B: Trend assessment of inputs to the Kattegat for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Total Nitrogen	Direct	-	Monotonic non-linear	LOESS level[9]	**D 55% Significant**	
	Riverine	A0[8]	Non-monotonic	LOESS level	**D 19% Not significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 21% Not significant**	
Total Phosphorus	Direct	-	Monotonic non-linear	LOESS level	**D 66% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 44% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 48% Significant**	
Cadmium	Direct	-	Non-monotonic	LOESS level	**D 71% Significant Not accepted**	Missing data from DK
	Riverine	A0	Non-monotonic	LOESS level	**D 24% Not significant**	Missing data from DK
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 32% Not significant**	Missing data from DK
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 69% Significant Not accepted**	Missing data from DK
	Riverine	A0	Non-monotonic	LOESS level	**U 7% Not significant**	Missing data from DK
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 24% Not significant**	Missing data from DK
Lead	Direct	-	Monotonic non-linear	LOESS level	**D 82% Significant Not accepted**	Missing data from DK
	Riverine	A0	Non-monotonic	LOESS level	**U 36% Not significant**	Missing data from DK
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**U 13% Not significant**	Missing data from DK

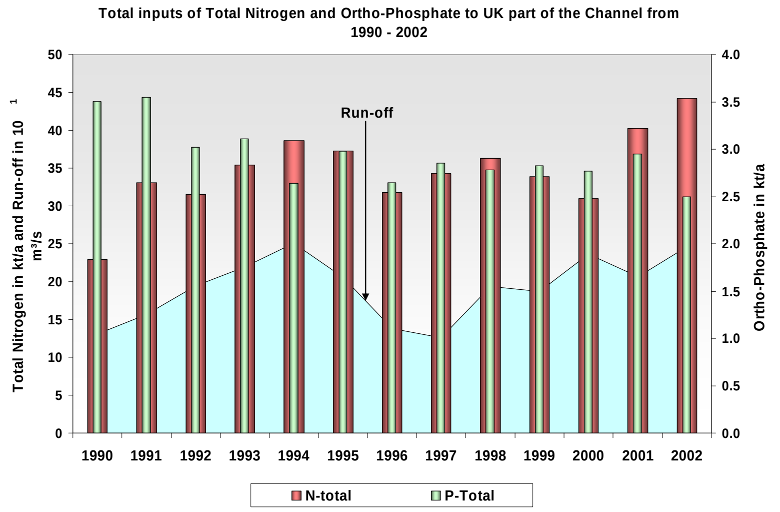
Key: U = upward; D = downward

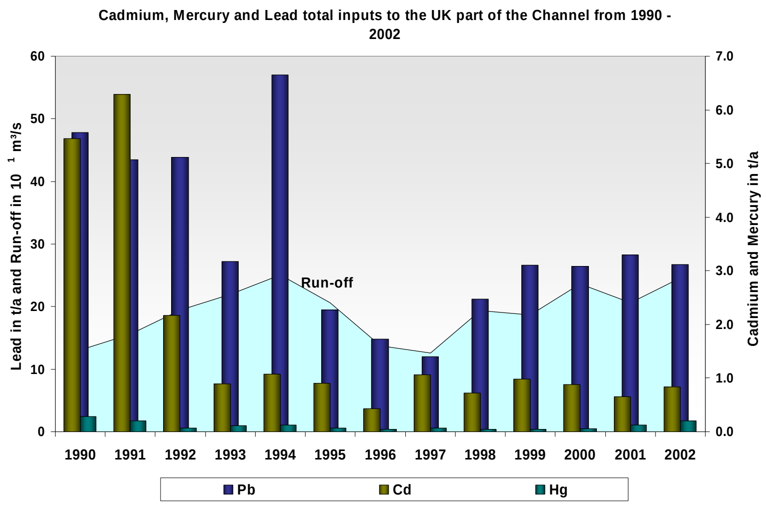
8.9 Region II 4: Channel (Annex 12)

This assessment is based on UK data only. As such, it is very limited. Table 12A below shows the basic inputs and flow data upon which the assessment of the (UK only) inputs to the Channel is based. The charts below show the total (direct and riverine) inputs of the five substances assessed and the riverine flows. The UK inputs to this sub-region represent the smaller part of all inputs to the Channel and currently about 2% of the inputs to the whole area of Region II. Annual riverine flows show a wide variation around the mean annual flow for the assessed period. Flows in the first two years were particularly low and those for 2000 and 2002 were high, thus indicating that flow-adjustment is desirable in order to reliably determine underlying trends in riverine inputs.

Table 12A: Basic data on inputs and flows to the Channel (only UK part)

	Direct discharges					Riverine inputs and flows					
Year	Tot-N kt/a	PO_4-P kt/a	Cd t/a	Hg t/a	Pb t/a	Tot-N kt/a	PO_4-P kt/a	Cd t/a	Hg t/a	Pb t/a	Q $10^3m^3/d$
1990	10.5	2.56	2.71	0.15	20.5	12	0.94	2.7	0.13	27.3	10265
1991	11.6	2.48	1.80	0.10	17.1	22	1.07	4.5	0.10	26.4	12387
1992	10.6	1.71	0.09	0.01	9.5	21	1.31	2.1	0.06	34.3	15764
1993	10.4	2.04	0.09	0.00	5.7	25	1.07	0.8	0.11	21.5	17845
1994	9.2	1.47	0.07	0.00	4.8	29	1.17	1.0	0.12	52.2	20682
1995	9.7	1.74	0.06		6.3	28	1.23	0.8	0.07	13.2	16772
1996	9.4	1.70	0.06	0.01	6.5	22	0.95	0.4	0.03	8.3	11886
1997	9.7	1.79	0.47	0.00	4.5	25	1.06	0.6	0.06	7.5	10845
1998	8.1	1.58	0.09		2.7	28	1.19	0.6	0.04	18.5	16723
1999	8.6	1.73	0.29	0.00	5.9	25	1.10	0.7	0.04	20.7	16150
2000	8.3	1.70	0.12	0.00	4.9	23	1.07	0.8	0.06	21.5	20433
2001	11.1	1.68	0.11	0.02	6.3	29	1.27	0.5	0.11	22.0	17816
2002	9.2	1.30	0.03	0.01	2.7	35	1.20	0.8	0.19	24.0	21222





The results of the assessment of UK inputs to the Channel are given in Table 12B. Apart from total Nitrogen, direct discharges showed significant downward trends. For 8 of the 15 determinand-load types that were assessed, acceptable downward trends were detected, namely for direct discharges, riverine loads and total inputs of Cadmium and Lead as well as for direct discharges and total loads of Ortho-phosphate Phosphorus. No significant trend could be observed for riverine loads and total inputs of Mercury; the trend analysis of direct discharges of Mercury is slightly questionable due to missing data for 1995 and 1998. Riverine inputs of Mercury were very low and showed an insignificant increasing trend. (A pattern of increased inputs in 2001 and 2002, which affected the assessment of the trend, was not reflected in 2003 inputs data.)

The riverine and total inputs of total Nitrogen and riverine inputs of Ortho-phosphate show a significant upward trend that is not accepted. The reason is that flow-adjustment was needed but could not be performed since the only available method for yearly loads (A0) was not applicable. Therefore, no significant upward trend with respect to the riverine inputs or the total inputs could be detected. The search for a possible trend will have to be done on the basis of more frequent data than the yearly loads or longer time series.

Table 12B: Trend assessment of inputs to the UK part of the Channel for the period 1990 – 2002

Determinand	Assessed load type	Adjustment	Assessment approach		Assessment results	
			Pattern	Method	Trend	Comments
Total Nitrogen	Direct	-	Non-monotonic	LOESS level[9]	**D 12% Not significant**	
	Riverine	Adjustment is necessary, but A0[8] is not applicable	Non-monotonic	LOESS level	**U [109%] Significant**	
	Aggregated	Adjustment for riverine loads is necessary, but A0 is not applicable	Non-monotonic	LOESS level	**U [58%] Significant**	
Ortho-phosphate	Direct	-	Monotonic non-linear	LOESS level	**D 42% Significant**	
	Riverine	Adjustment is necessary, but A0 is not applicable	Non-monotonic	LOESS level	**U [19%] Not significant**	
	Aggregated	Adjustment for riverine loads is necessary, but A0 is not applicable	Monotonic non-linear	LOESS level	**D [24%] Significant**	
Cadmium	Direct	-	Monotonic non-linear	LOESS level	**D 98% Significant**	
	Riverine	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 80% Significant**	
	Aggregated	Adjustment should not be applied	Monotonic non-linear	LOESS level	**D 87% Significant**	
Mercury	Direct	-	Monotonic non-linear	LOESS level	**D 91% Significant Not accepted**	Data gaps for 1995 and 1998
	Riverine	Adjustment should not be applied	Non-monotonic	LOESS level	**U 38% Not significant**	
	Aggregated	Adjustment should not be applied	Non-monotonic	LOESS level	**D 30% Not significant**	
Lead	Direct	-	Monotonic non-linear	LOESS level	**D 77% Significant**	
	Riverine	A0	Non-monotonic	LOESS level	**D 52% Significant**	
	Aggregated	A0 for riverine load	Non-monotonic	LOESS level	**D 60% Significant**	

Key: U = upward, D = downward, [%] – indicates that the trend is questionable as it is provisional because flow adjustment was required but could not be done.

9. Overall discussion of results and conclusions

Significant downward trends were identified for most direct discharges, especially those of the heavy metals Cadmium, Mercury and Lead. In absolute terms, the patterns of change in riverine inputs were less distinct, with a tendency for nutrients in some sub-regions to increase and for heavy metals to decrease over the assessed period. However, where flow adjustment was possible, a better underlying trend could be determined, and a greater number of downward trends was revealed. Generally, overall (direct and riverine) inputs showed significant downward trends, especially where it was possible to use flow-adjusted riverine inputs.

It appears that where a greater aggregation of inputs and, thus, larger input loads were found, like in Region II, more consistent results could be obtained. This may be due to the larger aggregation of inputs masking or reducing the influence of anomalies which can have a disproportionate effect on the assessment of a smaller aggregation of inputs.

The various assessments highlight the importance of ensuring that data sets for inputs and flows are as complete and consistent as possible before the (RTrend) assessment methodology is applied. Ideally, all significant anomalies should be addressed and Contracting Parties should be urged to complete their data sets. Any gaps should be made good by reviewing available monitoring data in the first instance. In the event that this is not possible, consideration should be given to the provision of dummy estimates. A sound justification should be provided for any adjustments or use of dummy estimates. It should be noted that, in some areas, it may not be possible to generate meaningful assessments in the foreseeable future without complete data sets.

For some data sets, there is an indication of under-reporting in the earlier years of the RID programme of inputs monitoring. This is a factor which could influence the outcome of any assessments by reducing any downward trends that are identified or increasing any upward trends. This is a matter that should be considered more carefully before the next main assessment of RID data. Where this is a material factor, one approach would be to reduce the period of assessment to include only those years for which data is more consistent.

Riverine flow rates have a greater or lesser influence on the level of riverine inputs, depending upon the substance concerned. For the particular period (1990 – 2002) assessed in this report, there was a wide variation around the mean annual flow. Often, flows in the first two years and in 1996 – 1997 were lower than average, and flows in 1994 – 1995 and in the last four years were above average. These factors indicate that flow-adjustment is desirable in order to reliably determine underlying trends in riverine inputs over this period. It does also indicate that for those few assessments, where flow-adjustment was needed but not possible, a more sophisticated adjustment technique, based on monthly data, should be applied or a longer period of assessment used, in order to produce more reliable results in terms of the underlying trends. This is an important factor to be taken into account where the results of the present input assessments are used in other assessments, or to evaluate the effectiveness of reduction measures.

The RTrend methodology has proved a useful tool in carrying out the individual assessments which have contributed to this overall assessment report. Due to the complexity of statistical methods applied and due to the variety of data taken into account (raw data, interpolated data, monthly data, annual data), the use of the software RTrend requires trained personnel. Only Belgium and Germany, who prepared the detailed RID trend assessments, gained from the experience of this trend assessment. In order to get experience in the application of the RTrend software, every Contracting Party should apply the software regularly to its annual national RID data. This could also serve as a tool of data quality assurance. It would also help if the individual assessments that are generated were more concise. Since INPUT has supported the continued use of RTrend, there would be a cost benefit in investing in its refinement, especially the development of an easy-to- apply procedure suitable for annual data sets of inputs and flows.

10. Recommendations

Where there is a high level of confidence in the results of assessment, such results can be used without qualification. However, where there is less confidence in the data or results, due acknowledgement of the limitations of the data or the results of assessment should be made.

For the benefit of any future assessments, greater effort should be made to address any significant anomalies or gaps in inputs or flow data, or significant under-reporting in the earlier years. To this end, Contracting Parties should make periodic reviews of their data to identify, and seek to resolve, any items of significance, and report to INPUT with justified proposals on how to compensate for any gaps, anomalies or under-reporting. Ideally, in undertaking any future assessment work, INPUT should ensure that for each sub-regional assessment there is someone directly involved who has local knowledge pertaining to data being assessed.

Given the importance of reliable riverine flow data in assessing riverine inputs, INPUT should consider reinforcing the requirement for completeness and reliability in such reporting in the RID Principles. Additionally, INPUT should consider means of evaluating (statistically describing the variation of) riverine flows so that such an evaluation can form the first part of the related riverine input assessment with RTrend.

Given that it is an important region in respect of inputs, and that a reliable assessment will be needed for the QSR 2010, special effort should be made to enhance the completeness and consistency of the inputs data for Region III. Consideration should also be given to supplementing the regional assessment of the Celtic Seas by assessments of inputs to each of its three sub-regions. To this end, the UK and Ireland should cooperate to ensure that good data sets are available by INPUT 2007.

Recognising that inputs data sets are not so well developed for Region IV as they are for other regions, INPUT should consider how best to progressively build up and present the data that is available for Region IV, and seek to undertake assessments as, and when, sufficient time series of consistent data become available, either on a local or a wider spatial scale. To this end, France, Portugal and Spain should cooperate (bilaterally where appropriate) to generate data sets suitable for undertaking assessments at the regional or sub-regional level, with a view to reporting to INPUT 2007 accordingly.

Given that assessment of RID data is very demanding of resources, INPUT and specialists concerned should seek to streamline the assessment and reporting as much as possible. To this end, INPUT should encourage maximum use of standard tables, which can be easily updated, for presenting data and the results of assessment. Also, it should be an objective (of the (RTrend) approach to assessing data) to generate a standard summary report which conveys the essential information in a minimum number of pages.

In anticipation of the wider use of RTrend, feedback on the resource implications of its use should be obtained and resources should be found for the maintenance and refinement of the RTrend software as well as for user support in the initial phase of application. These actions should be effected before the next main assessment is started.

In view of the needs of the Joint Assessment and Monitoring Programme, including the assessment of the eutrophication status of the OSPAR Convention area under the Common Procedure, and the anticipated timing of the QSR 2010 preparations, a further main assessment of inputs data should be made in 2007. With this in mind, Contracting Parties concerned and INPUT should investigate how best to update their data sets, in a fully transparent manner, in order to make available the best possible data sets for the next main assessment.

Although there is scope for adding extra substances in future RID data assessments, such additions should only be considered as, and when, adequate and comprehensive data sets become available. If there is an overriding need for OSPAR to assess the inputs of any additional substances before such data sets are available, any such assessment should be done as a one-off exercise, limited to those areas where there is a specific need and adequate data is available.

11. Glossary

A0	Flow-adjustment method for annual load data which takes into account the ratio between the actual annual run-off and the long-term annual run-off
aggregated inputs	See “total inputs”
ASMO	OSPAR Environmental Monitoring and Assessment Committee
CAMP	OSPAR Comprehensive Atmospheric Monitoring Programme (reference number: 2001-7), as amended by INPUT 2005 (Annex 4 of the INPUT 2005 Summary Record, INPUT 05/8/1)
Cd	Cadmium
CEMP	OSPAR Coordinated Environmental Monitoring Programme (reference number: 2004-16)
direct discharges	A mass of a determinand discharged to the maritime area from point sources (sewage effluents, industrial effluents or other) per unit of time at a point on a coast or to an estuary downstream of the point at which the riverine estimate of input is made.
direct inputs	See “direct discharges”
heavy metals	Refers to the three heavy metals whose direct discharges and riverine inputs were examined in this assessment of OSPAR inputs data: Cadmium, Mercury and Lead.
Hg	Mercury
INPUT	OSPAR Working Group on Inputs to the Marine Environment
JAMP	OSPAR Joint Assessment and Monitoring Programme (reference number: 1997-17)
JAMP Guidance	JAMP Guidance on Input Trend Assessment and the Adjustment of Loads (reference number: 2003-9), as amended by ASMO 2005 (Annex 8 of INPUT 2005 Summary Record, INPUT 05/8/1).
JAMP product	One of the tasks set out in the 2003 Strategy for a Joint Monitoring and Assessment Programme (reference number: 2003-22), as amended by OSPAR 2004 and 2005.
LOESS level	Decribes a trend assessment technique based on the underlying non-linear trend.
Mann-Kendall (MK)	A non-parametric trend assessment technique for detecting monotonic trends.
nutrients	Refers to the nutrients whose direct discharges and riverine inputs were examined in this assessment of OSPAR inputs data: total Nitrogen, total Phosphorus and, specifically for the Channel, Orthophosphate Phosphorus.
OSPAR	OSPAR Commission (established by the Convention for the Protection of the Marine Environment of the North-East Atlantic)
Pb	Lead
PO_4-P	Orthophosphate Phorphorus
QSR 2010	OSPAR Quality Status Report due in 2010
RID	Comprehensive Study of Riverine Inputs and Direct Discharges (reference number: 1998-5), as amended by ASMO 2005 (Annex 5 to the ASMO 2005 Summary Record, ASMO 05/13/1).
riverine inputs	A mass of a determinand carried to the maritime area by a watercourse (natural river or man-made watercourse) per unit of time
RTrend	Software program developed by *quo data* for the statistical analysis of riverine loads.
Theil slope	A non-parametric, outlier-resistant estimation method for linear trends.
total input	Sum of direct discharges and adjusted or unadjusted, as the case may be, riverine inputs.
total-N	total Nitrogen
total-P	total Phosphorus