Technical Report No.8

A European Inventory of Emissions to Inland Waters

A first proposal

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EXECUTIVE SUMMARY

Emissions registers and inventories are important tools for the formulation and monitoring of pollution control policies.

This report describes the progress made within the European Environment Agency's (EEA) work programme in defining an overall framework methodology for a European inventory of emissions to water. The aim is to establish a simplified, robust approach which could provide for the various users a minimum set of reliable data in the short term taking into account the difficulties inherent in water emissions assessment. The possibility that a water emissions inventory could be treated as an extension of the CORINAIR system for inventorising emissions to air is considered and discussed.

Emissions inventories are multi-purpose databases designed to meet the needs of different policy objectives such as:

- development of technical and regulatory measures to reduce emissions (e.g. specific information on sources);
- monitoring of measures already in force;
- analysis of the relationships between economic factors and emissions and between emissions and state of the environment in the context both of the development of regulatory measures and of assessment of the impact of existing measures;
- providing information to the general public.

The approach taken by the European Topic Centres on Inland Waters and Air Emissions (ETC/IW and ETC/AE) in the preparation of this report concentrates on four main issues:

- **The substances to report**. Determinands to be selected should represent a pollution threat to the environment. Methods to be used for the selection should be based on legal requirements, environmental needs, and feasibility. Compatibility with the substances used by other international organisations is an important criterion.
- **The sources generating emissions.** These should be described either in terms of economics or the processes involved.
- **The spatial scale for reporting**. The river or lake basin is the relevant unit for the assessment of emissions to water in line with the catchment management approach taken more broadly. For the purposes of the EEA, it seems reasonable and appropriate to consider only the topographic surface catchments. There are potential problems in that currently much pressure data is gathered on the basis of administrative units rather than the catchment level.
- **The time scale for reporting**. The current definition most commonly used for air emissions inventories is "the mass of substance emitted per year to the atmosphere". For water issues, different temporal resolutions are needed for different purposes although annual reporting will still be appropriate for many legal purposes and for state of the environment reporting.

Emission inventories are required under a number of EU directives aimed at controlling and reducing pollution in the water environment. Many of these directives are likely to become subsumed under the proposed Water Framework Directive but the need for Member States to monitor and collect information on the state of inland waters and the pressures arising from catchment activities will still be a fundamental legal requirement. In particular, the Integrated Pollution, Prevention

and Control (IPPC) Directive requires the Commission to report every three years an inventory (Polluting Emissions Register - PER) of the “principal emissions and sources” based on data supplied by the Member States.

EEA’s information needs on pollution sources are governed by its obligations for “provision of timely, targeted, relevant and reliable information to policy making agents and the public”. Part of this work consist of regular reporting on the state of the environment, e.g. the Dobríš assessment and updates and the EU State of Environment reports.

These needs are likely to increase and evolve as a result of the integrated assessments of environmental problems being carried out by a range of programmes and organisations including the EEA and its Topic Centres.

In Europe, the available information on water pollution sources can be divided into registers on Urban Waste Water (UWW), Industrial Waste Water (IWW) and Diffuse Pollution Sources Registers (DPSR). Existing sources of information have been reviewed and their relevance to the EEA assessed.

A guideline methodology for the estimation of point and diffuse source emissions to water has been prepared and is presented in this report. This has been based on existing models used in France, Denmark and the Netherlands.

1. INTRODUCTION

1.1. Objectives

The EEA assessment framework of Driving forces, Pressures, State, Impact and Response (DPSIR) is a key concept for the analysis and reporting of environmental problems in Europe. The relationship between these factors has been analysed and modelled in numerous studies, particularly dealing with eutrophication. A driving force could be the population density (emission of excreta, detergents etc.), the pressure is the resulting emission to the water (driving force modified by waste water treatment technology), and the state is the resulting environmental quality. The impact on society may be threats to health or deterioration of recreational values, which requires political responses to reduce the problem. For a particular water body it is thus important to link environmental state and pressure at an appropriate level, widely recognised as the catchment.

Emissions registers and inventories are important tools for the formulation and monitoring of pollution control policies. Within EEA, two initiatives were included in the 1997 and 1998 work programmes of both ETC/AE and ETC/IW with the objective of developing common approaches to emissions to air and water with a longer-term aim of producing a conceptual model for an integrated emission inventory (IEI).

- Proposals for a **PER** (Polluting Emissions Register) under the IPPC (*Integrated Pollution Prevention and Control*) Directive, adopted by the Council in September 1996, are to be developed with the support of ETC/AE and ETC/IW. The PER will include emissions of a list of specified pollutants from a group of large industrial installations. The PER is intended to include emissions to air and water and possibly generated waste.

- ETC/IW is to draft a **methodology for estimating emissions to water**, including the requirements from various EU Directives (such as the proposed Water Framework Directive). This work is therefore intended to address all IPPC and non-IPPC point sources of emissions to water as well as diffuse sources. The expected outputs are a report with proposed methodology and preliminary guidance material e.g. emissions factors. The methods for estimating emissions to air are considered to be well covered in the EMEP/CORINAIR Atmospheric Emission Inventory Guidebook (EEA, 1996) and treated by the CORINAIR software developed by ETC/AE.

This report describes the progress made in defining an overall framework methodology for a European inventory of emissions to water. The aim is to establish a simplified, robust approach which could provide for the various users a minimum set of reliable data in the short term taking into account the difficulties inherent in water emissions assessment. The possibility that a water emissions inventory could be treated as an extension of the CORINAIR system for inventorising emissions to air is considered and discussed.

1.2. Scope

The recent work carried out by the ETC/IW and others on updating the Dobris assessment, producing a monograph assessing the impact of excessive nutrients on the environment and piloting an integrated environmental assessment on eutrophication has clearly demonstrated that the weakest point in all these

assessments is the non-availability, incomparability and heterogeneity of data on pressures (i.e. emissions from point and diffuse sources) within catchments.

Emissions inventories are multi-purpose databases designed to meet the needs of different policy objectives such as:

- development of technical and regulatory measures to reduce emissions (e.g. specific information on sources);
- monitoring of measures already in force;
- analysis of the relationships between economic factors and emissions and between emission and state of the environment in the context both of the development of regulatory measures and of assessment of the impact of existing measures ;
- providing information to the general public.

The approach taken by ETC/IW and ETC/AE concentrates on four main issues:

- **The substances to report**. Determinands to be selected should represent a pollution threat to the environment. Methods to be used for the selection should be based on legal requirements, environmental needs, and feasibility.
- **The sources generating emissions.** These to be described either in terms of economics or the processes involved.
- **The spatial scale for reporting**. The river or lake basin is the relevant unit for the assessment of emissions to water in line with the catchment management approach taken more broadly. For the purposes of the EEA, it seems reasonable and appropriate to consider only the topographic surface catchments. There are potential problems in that currently much pressure data is gathered on the basis of administrative units rather than the catchment level.
- **The time scale for reporting**. The current definition used for air emissions inventories is “the mass of substance emitted per year to the atmosphere”. For water issues, different temporal resolutions are needed for different purposes although annual reporting will still be appropriate for many legal purposes and for state of the environment reporting.

The scope of this report is limited to emissions to inland waters from all potential sources. The long-term perspectives of combining a European Water Emission Inventory with the currently existing CORINAIR inventory on air emissions into an Integrated Emission Inventory (IEI) are discussed and, where relevant, the experiences of the existing air emission inventories are presented and analysed. An IEI is a database covering in principle all emissions from all sources to all media. The benefits such as common methodologies, consistent nomenclatures and the integration of different sectors, pollutants and media are expected to be valuable in an integrated pollution control context (Briggs, 1993). However, the difference between media regarding the significance of different sectors, pollutants and pathways requires special attention. It should be considered carefully to which extent the needs in relation to different media can be integrated in one emission inventory.

The report summarises the legal framework for reporting inventories of emissions to inland waters. The existing sources of information are reviewed and methodologies to estimate emissions to water are proposed and discussed. Finally conclusions and recommendations are presented regarding the design and development of a European Water Emission Inventory.

2. LEGAL FRAMEWORK FOR REPORTING EMISSIONS INVENTORIES TO WATER

2.1. Requirements for EU directives (proposed Water Framework Directive and other water related Directives)

The proposed Water Framework Directive (WFD) requires that all measures to achieve the environmental objectives for sustainable protection and use of water are co-ordinated and their effects overseen and monitored within river basins, thus ensuring that Community policy is applied in a coherent and rational way. The directive will cover quantity and quality aspects of all surface waters and groundwater.

There are requirements for Member States to monitor water bodies and collect information on the state of the environment and the pressures placed upon it. In particular, Article 6 'Review of the environmental impact of human activity' (COM(97) 49 final) requires estimations, at the River Basin District level, of point and diffuse sources of pollution and analysis of other anthropogenic influences on the status of water. Article 13 'Programme of measures' requires a combined approach when establishing measures covering emission of pollutants. This approach includes pollution control at source through emission limit values and environmental quality standards.

Several other directives deal with aspects of water policies and management (some of which are to be repealed or revised once the requirements are incorporated into the WFD). These include:

- GW: Groundwater directive (80/68/EEC) - to be repealed
- DS: Dangerous substances (76/464/EEC) - probably to be repealed
- SW: Surface water directive (75/440/EEC) - to be repealed
- F/S: Freshwater fish (78/659/EEC) and Shellfish water (79/923/EEC) directives - to be repealed
- ECO: Proposed ecological directive (COM(93)680) - to be replaced by WFD
- EOI: Exchange of information decision (77/795/EEC) - to be repealed or revised
- DW: Drinking water directive (80/778/EEC)
- BW: Bathing water directive (76/160/EEC)
- IPPC: Integrated pollution prevention and control (96/61/EEC)
- UWW: Urban waste water directive (91/271/EEC)
- N: Nitrate directive (91/676/EEC)
- TIT: Titanium dioxide directive (82/883/EEC)

Emission inventories are particularly important in relation to source-oriented directives such as the Dangerous Substances, IPPC, UWW and Titanium Dioxide directives (grey shading in table 1).

The character of the determinands in table 1 is highly variable. Substances may be single compounds (Dieldrin), species of a related group of compounds (e.g. nitrogen - NO3, NH4, total N) or more complex, functional groups of compounds (organic matter = oxygen consuming substances). Some substances have more than one impact on the aquatic environment, e.g. ammonia acts both as an oxygen consumer and a nutrient.

Table 1: Determinands required or recommended in various directives.

Part a: basic determinands and organic matter.

Directive	GW (*)	DS	SW	F	S	ECO (*)	EOI	DW	BW	IPPC (**)	UWW	N	TIT
Media (M) Source (S) oriented	**S+M**	**S**	**M**	**M**	**M**	**M (S)**	**M**	**M**	**M (S)**	**S**	**S (M)**	**M (S)**	**S+M**
Smell			+					+					
Taste								+					
Colour			+		+				+				
Temperature			+	+	+		+	+					+
Turbidity			+					+					+
Conductivity			+				+	+					+
Salinity					+								+
pH			+	+	+		+	+	+				+
Susp.solids			+	+	+						+		+
BOD			+	+			+				+		
COD			+				+				+		
TOC(tot.org.carbon)			+										
ROC(res.org.carbon)			+										
DO			+	+	+		+		+				+
Ca													+
Cl			+				+						+

Part b: metals and undesirable anions.

Directive	GW (*)	DS	SW	F	S	ECO (*)	EOI	DW	BW	IPPC (**)	UWW	N	TIT
Media (M)/ Source (S) oriented	**S+M**	**S**	**M**	**M**	**M**	**M (S)**	**M**	**M**	**M (S)**	**S**	**S (M)**	**M (S)**	**S+M**
F			+										
SO_4			+										+
Ag					+								
As			+		+				+				
Ba			+										
Be			+										
Bo			+										
CN			+						+				
Co			+										
Cr			+		+				+				+
Cu			+	+	+								+
Fe			+										+
Pb			+		+				+				+
Mn			+										+
Ni			+		+								+
Sn													+
Se			+										
Vn			+										+
Zn			+	+	+								+

Part c: eutrophication.

Directive	GW (*)	DS	SW	F	S	ECO (*)	EOI	DW	BW	IPPC (**)	UWW	N	TIT
Media (M)/ Source (S) oriented	**S+M**	**S**	**M**	**M**	**M**	**M (S)**	**M**	**M**	**M (S)**	**S**	**S (M)**	**M (S)**	**S+M**
Tot. P/ phosphate			+	+			+		+		+		
Total nitrogen			+						+		+		
Nitrate			+				+	+	+			+	
Nitrite				+				+					
Ammonia/ ammonium			+	+			+	+	+				

Part d: organic micropollutants.

Directive	**GW (*)**	**DS**	**SW**	**F**	**S**	**ECO** (*)	**EOI**	**DW**	**BW**	**IPPC** (**)	**UWW**	**N**	**TIT**
Media (M)/ Source (S) oriented	**S+M**	**S**	**M**	**M**	**M**	**M (S)**	**M**	**M**	**M (S)**	**S**	**S (M)**	**M (S)**	**S+M**
Chlorine			+	+				+					
Hg		+	+		+		+		+				
Cd		+	+		+		+		+				+
Surfactants			+				+		+				
Hexachlorocyclohexane		+											
Carbon tetrachloride		+											
DDT		+											
Pentachlorophenol		+											
Phenol			+	+					+				
Petroleum hydrocarbons				+	+								
Diss.hydrocarbons			+										
PAH's			+										
Mineral oils									+				
Tarry res.& floating materials									+				
Total pesticides			+						+				
Aldrin		+											
Dieldrin		+											
Endrin		+											
Isodrin		+											
Hexachlorobenzene		+											
Hexachlorobutadiene		+											
Chloroform		+											
1,2-dichloroethane		+											
Trichloroethylene		+											
Perchloroethylene		+											
Trichlorobenzene		+											
Organohalogenated subst.					+								
Substance extractable with			+										

Part e: microbiology and pathogens.

Directive	**GW (*)**	**DS**	**SW**	**F**	**S**	**ECO** (*)	**EOI**	**DW**	**BW**	**IPPC** (**)	**UWW**	**N**	**TIT**
Media (M)/ Source (S) oriented	**S+M**	**S**	**M**	**M**	**M**	**M (S)**	**M**	**M**	**M (S)**	**S**	**S (M)**	**M (S)**	**S+M**
Total coli			+				+	+	+				
Faecal coli			+		+		+	+	+				
Faecal Streptococci			+				+	(+)	+				
Salmonella			+				+	(+)	+				
Enteroviruses								(+)	+				
Faecal bacteriophages								(+)					
Sulphite-reducing								(+)					
Total bacteria								+(22/					
Pathogenic Staphylococci								(+)					

Legend: (*):not specified; (**) : only specified in general terms

2.2. The IPPC directive and the requirement for a Polluting Emissions Register

Under the IPPC Directive there is a requirement to report to the Commission every three years an inventory of the "principal emissions and sources" based on data supplied by the Member States. The EEA agreed with DGXI to provide support in developing a proposal for a Polluting Emissions Register. The PER will include reported emissions of a list of specified pollutants from a group of large industrial installations, which are listed explicitly in the annex of the directive. The design of the PER, including the specification of information to be reported will have to be agreed upon by an ad hoc committee established under the IPPC Directive. This committee met for the first time November 1997. The corresponding task of the committee is to deal with the development of a methodology for estimating emissions from IPPC point sources to air and water as well as generated waste, including the relevant legal requirements.

The IPPC Directive lists the benefits of integrated pollution control and assessment. The main objective is that "Integrated pollution control" aims at considering all possible sources of emissions, in order to discourage shifting of pollution between the various media to the disadvantage of the environment as a whole.

Proposals for a list of substances to be reported under the IPPC Directive have been prepared by DGXI, but no decision has been taken. The above-mentioned committee will prepare further proposals in 1998.

The Swedish EPA (SEPA, 1997) has recommended a stepwise approach based on existing national inventories. This will enable building up a PER including a limited number of pollutants within a reasonable time and without imposing excessive cost and effort on Member States.

2.3. EEA regular reporting and information needs

EEA's information needs on pollution sources are governed by its obligations for "provision of timely, targeted, relevant and reliable information to policy making agents and the public". Part of this work consist of regular reporting on the state of the environment, e.g. the Dobríš assessment and updates and the EU State of Environment reports.

These needs are likely to increase and evolve as a result of the integrated assessments of environmental problems being carried out by a range of programmes and organisations including the EEA and its Topic Centres.

Results already available permit the identification of the main substances which are involved in water pollution and therefore deserve special attention in emission inventories. Those substances are presented in Table 2 (the Exchange of Information Decision [77/795/EEC] is similarly relevant and the substances it requires are also included in the table).

The number of substances listed in this table is lower than the number included in the Directives. Reporting the general state of the environment at the European scale requires relatively few but informative and consistent indicators or data sets, which can be individual or aggregated substances. Many substances required in the Directives are site specific or source specific (e.g. industrial discharges) and therefore require a different approach which, for instance, takes into account the nature of receiving water bodies.

Table 2: Most relevant determinands in relation to various environmental themes

Themes: **P.H**: Public health, **O.P**. Organic pollution, **S**. Salinity, **Eut**. eutrophication/nutrients/groundwater nitrate, **T.M** Toxicity, metals, **T.O**., Toxicity, organic, **Acd**. Acidification, **Rd**., Radioactivity.

Theme	P.H.	O.P.	Sal.	Eut.	T.M.	T.O.	Acd.	Rd.
BOD		+						
COD		+						
DO		+		(+)				
Phosphorus (total or SRP)				+				
Nitrogen (total or nitrate)				+				
Ammonia/-um	(+)	+		+				
Total coli	+							
Faecal coli	+							
Faecal Streptococci	+							
Salmonella	+							
SO_2 (via air)	**(in air)**						+	
No_x (via air)	**(in air)**			(+)			+	
Cl			+					
Cd	+				+			
Cu	(+)				+			
Cr	+				+			
Hg	+				+			
Pb	+				+			
Zn	(+)				+			
Ni	+				+			
DDT						+		
PCB	+					+		
PAH	+					+		
Total pesticides						+		
Cs-137								+
Sr-90								+

Remark: SO_2 and NO_x are examples of substances with very different impact in air and water. In the atmosphere they may affect human health or cause climatic changes. In water they contribute to acidification or eutrophication.

The seven metals included in the Toxicity/Metals theme (table 2), are mentioned in the Titanium Dioxide Directive along with several others. Several metals are also included in the Surface Water, Shellfish and Bathing Water directives. The two metals for which reporting is most frequently required are mercury and cadmium.

No directives require reporting on specific determinands of radioactivity.

Organic micropollutants including pesticides are very difficult to address fully due to the huge number of substances. Key substances (e.g. HCH) or aggregated determinands (e.g. PAHs) may be used as indicators. The key problems of the theme change over time. For example, DDT has been banned for decades and is a decreasing problem, whereas the many new pesticides and their breakdown products are potential problems of the future. The diffuse nature of pollution by pesticides

along with unknown processes in the pathways (soil) further complicates the source oriented assessment of such pollution. The industrial outlet of organic micropollutants also comprises many substances. Both individual substances (the most hazardous or commonly discharged) and functional aggregates (e.g. PAHs) are required to be registered.

2.4. Conclusion

Considering the above analysis, Table 3 presents a list of substances recommended to be included in the first approach to prepare a European Water Emission Inventory (WEI).

Table 3: Proposed list of substances to be included in the WEI (First Approach)

Determinand	**Unit of reporting**	**Comments**
BOD_5	tonnes of O_2 $month^{-1}$	Monthly values are needed for environmental assessment. In most cases, they are derived from yearly values divided by 12
COD	tonnes of O_2 $month^{-1}$	
Total phosphorus	tonnes of P $month^{-1}$	Monthly values are more critical for nutrients than for organic pollution. However, it is expected that these values will be derived from annual loads broken down to the relevant period
Total nitrogen	tonnes of N $month^{-1}$	
Ammonia	tonnes of $N\text{-}NH_4$ $month^{-1}$	
Cu, Hg, Cd, Pb, Zn, As	kg of X $year^{-1}$	This list of substances covers most of the basic needs for reporting and environmental assessment. Other substances could be included as well To be included later
PAH's	kg of X $year^{-1}$	To be included later
(other compounds of the Dangerous Substances Directive)	kg of X $year^{-1}$	To be included later

Total nitrogen and phosphorus are considered more solid indicators of eutrophication than the various N and P compounds due to their rapid transformation in the environment. Ammonia is an exception due to its potentially toxic effect.

3. REVIEW OF SOURCES OF INFORMATION

3.1. Introduction

The available information in Europe on sources of pollution to water can, for practical reasons, be divided into registers on Urban Waste Water (UWW), Industrial Waste Water (IWW) and diffuse pollution sources (DPS).

In section 3.4, the characteristics of pollution source registers in a number of European countries are outlined on the basis of a study carried out for the DGXI (VKI *et al.*, 1997).

There are several statistical databases on population density, land-use etc., which may be used for estimating emissions if more detailed information is not available. Moreover, several countries carry out or envisage to undertake estimation of source apportioned pollution load to water bodies. These estimates are based on a combination of measured river transport, monitored or estimated point source discharges and area sources calculated by coefficients or as a residual (see table 6).

Each of these data sources is constructed according to a specific nomenclature, which is more or less comprehensive. Currently used nomenclatures are reviewed in section 3.3.

The main issue of this project in conjunction with the activities of ETC/AE on air emission inventories is to improve the long term data collection system (which is based on ad hoc nomenclatures) and the short term data collection system where the available information is heterogeneous.

3.2. Nomenclatures for emission inventories

A nomenclature is **a system of classification of a domain that is used to describe, name and easily retrieve relevant information.**

The domains important to emission inventories are:

- The economic domain, where activities produce economic goods or added value,
- The emitters of pollution (for instance activities), considered as sources of releases,
- The substances emitted,
- The receiving media.

Each of the domains listed above is described in different levels of detail by one or several nomenclatures used by regional, national or international authorities. Most of these nomenclatures are not fully consistent with the others of the same kind, and none of those currently applied covers the totality of the domain it is intended to describe. A European Water Emission Inventory should use a modified (probably simplified) version of existing nomenclatures suitable for analyses of the relationships between pollution pressure and environmental state.

The problems to solve are therefore:

To define the nomenclature for the European Water Emission Inventory;

To determine how to use this nomenclature in data collection;

To determine how to use the existing nomenclatures and adapt them to the specific needs for a European Water Emission Inventory.

3.3. Nomenclatures in use

3.3.1. Economic domain oriented nomenclatures

One of the issues of a WEI is to elucidate the relationship between the economic sectors (which are addressed by the Driving forces concept of the DPSIR methodology) and the emissions resulting from the corresponding processes. The second important issue is the relationship between the expenditures devoted to pollution control or emissions abatement and the resulting pressure and environmental state.

The EU standard statistical nomenclature for economic activities (NACE) is used for economic statistics. Using NACE also for emission data enables aggregations corresponding to economic sectors. NACE is closely related to the Nomenclature Of Sources of Emissions (NOSE), presented in section 3.3.3.

For more details on nomenclatures, see Annex I.

3.3.2. Nomenclatures related to emission generating processes

There are several national and international nomenclatures dealing with emission generating processes, or more generally with polluting activities. The main parts of these source nomenclatures are the activity characteristics describing the quantities of the item involved in emission and its related emission factors.

The SNAP nomenclature (Simplified Nomenclature for Air Pollution) was developed for the CORINAIR project and is currently used for preparing national air pollution inventories in Europe. It has the strength of being used in practice, but it has been designed for atmospheric pollution purposes and the categories used may not be the most relevant for water pollution.

The NOSE nomenclature (Nomenclature Of Sources of Emissions) is currently being developed by Eurostat in collaboration with EEA and Member States. The NOSE-P (process list) includes the processes defined in SNAP and links directly to the NACE branch nomenclature. Eurostat is currently testing NOSE in its present state. There is still much work to do before NOSE is operational, e.g. the linking between NACE branches and NOSE processes is not yet fully developed. NOSE is developed from CORINAIR, which means that the classifications of sectors and processes are tailored for air emissions, taking into account all activities emitting a range of specific substances to air. However, the range of substances relevant to water is quite different as are the most important emission sources. It will require substantial effort to make NOSE applicable to water issues.

The ACCOR nomenclature developed by CITEPA has been proposed as an alternative to the NOSE-P, but it is also far from being fully developed.

There are also national nomenclatures in some countries. The French TEF nomenclature covers 370 industrial activities causing pollution to water and is used for tax calculation purposes. The nomenclature of the Dutch emission inventory covers ten economic sectors and about 1000 source classes including industrial processes.

For more details, see Annex I.

3.3.3. Nomenclatures related to substances

Relating environmental state to emissions often involves mass balance calculations. This calls for a common nomenclature between substances in the aquatic environment and substances emitted to water. However, most emission inventories including CORINAIR have covered few pollutants and there has been no need for a nomenclature. The WEI will similarly consider relatively few pollutants, at least in the first stages.

3.3.4. Nomenclatures related to location of sources of pollution and recipients

There is no systematic relationship between the location of a source of pollution and the water recipient. Wastewater is often transported a long distance through a sewer before discharging to the recipient. Similarly diffuse pollution has complex pathways through soil. These complex pathways differ significantly from those relating to air pollution and complicate the adaptation to water of methods applied in air emission inventories.

The distinction is very important since most emission data computed from activity and emission coefficients are reported as situated at the initial production site, whereas direct measurements are likely to be reported as situated at the emission outlet. For the purpose of relating emissions to the state of the aquatic environment, the information of importance is the point of discharge to water.

Diffuse sources can belong to one of the following categories:

Agricultural land,

Natural or semi-natural land,

Artificial land, which may be assimilated to a point source or area source (urban areas, industrial areas, airports, etc.),

Linear features, such as highways, railways, etc.

It is recommended that, for the first three items, the CORINE Land Cover nomenclature should be used. This allows comparable allocation of emissions to portions of land situated in a given territory. For initial testing only the main classes of CORINE should be used.

A methodology of dealing with linear features should be developed at a later stage unless it can be verified that they are not important to water.

The *topographic surface watershed* has been designated as the relevant unit for a Water Emission Inventory. This is the portion of territory that can be delimited by the line of crest (by hand, considering the curve levels, or using a Field Numerical Model and GIS software). This watershed is not the actual drainage area of the river that drains it. For large watersheds, the difference between the real drainage area and the topographic surface watershed is negligible. In small catchments there may be larger deviations, which should only be dealt with as a lack of precision. Very karstic catchments can be impacted by emissions far away from the topographic watershed area. Special calculation methods may need to be used in such areas.

A GIS river and catchment database has recently been developed for DGXI along with a unique hierarchical codification system. This should be used as the framework for codification and aggregation at river basin level.

For a Europe-wide water emission inventory it will be appropriate to use catchments with an area between 100 and 10 000 km^2 for codification of the recipient of an emission.

3.4. Registers and data available

3.4.1. Determinands currently registered

Table 4 summarises results of a survey on emission inventories in the EU countries and Norway and Switzerland. Four distinct types of inventories have been distinguished: source-oriented registration of urban waste water, industrial waste water, diffuse pollution and media-oriented source-apportioned pollution load calculations. The approach and coverage differs between countries, but the table indicates the relative concern for a number of substances. For details on geographical coverage etc. see VKI et.al., 1997.

There is a relatively clear-cut pattern for the pollutants registered for the various kinds of pollution sources.

Table 4: Number of countries registering various determinands for different types of pollution sources or in a source-apportionment context.

Determinands	Urban Waste Water	Industrial Waste Water	Diffuse sources	Source-apportionment
BOD_x	16	13	3	4
COD	13	13	2	4
Total N	13	11	5	11
NH_4-N	13	11	4	8
NO_{23}-N	9	9	4	7
Total P	14	12	6	10
PO_4-P	10	5	4	9
Metals (one or more)	9	10	3	6
Organic micro-pollutants	4	9	2	6
Radioactive elements	*1*	*2*		
Bacteria	*1*	*0*		

Source : VKI et al., 1997

The key substances for point sources are oxygen consuming substances (BOD_x, usually BOD_5), nutrients (total P, total N), metals and for industrial sources some organic micropollutants. Regarding diffuse sources and source apportionment, nutrients are dominating.

Information on the metals or organic micropollutants registered is not very detailed, but it is assumed that the substances are selected on the basis of production type - the substances known to be a problem in a certain branch are considered with the greatest interest.

The four last lines of the table, shaded in light grey, deal with determinands that are not suitable for flux assessment. They are therefore not recommended for the first stage of a European WEI.

Radioactive elements are a locally significant problem and are usually not dealt with in the general registers. However, it can be assumed that the emissions from the most important facilities are controlled by the authorities.

Similarly bacteria are generally not included in these registers. They are indicators of poorly treated waste water and due to a rapid turn-over time a monthly discharge is

not very informative. Bacteria are rather monitored as concentration in water in relation to compliance assessment.

3.4.2. The sources registered

The "PE", or population equivalent, is commonly used as a unit for amounts of wastewater, even industrial wastewater. It corresponds to the average daily emission of substances from one person.

The PE numerical values of emission are quite variable amongst countries, and reasons for the value selected are not well documented, nor the emitted substances used for definition of the PE.

The criteria for registering emissions from individual UWWTP varies very much between countries. Spain uses a limit of 10 000 PE, whereas e.g. France uses a limit of 200 PE, Denmark of 30 PE and England, Scotland and the Netherlands has no lower limit. Many countries assess the emissions from smaller UWWTP, untreated sewage and scattered population by coefficients. It is not clear if these coefficients address only persons emission or if they include an extra value to account for unregistered urban activities.

Some countries have information on the industries connected to the sewage system, but the proportional contribution from each installation is usually not known.

For direct industrial discharges, the information available also differs substantially. As for urban waste water, the major facilities are subject to greater attention by the authorities than smaller ones. The criteria for registering an individual outlet are not clearly defined in many countries.

Diffuse pollution is either calculated on the basis of coefficients (area-, population-specific) or indirectly as part of a source apportionment of the pollution load to a water body. There is some overlap between point and diffuse sources. For instance the pollution from scattered dwellings may be considered as either a point source or a diffuse source. The source types typically included in registers are listed in Table 5. The most frequently used categories of pollution sources are urban waste water treatment plants, directly discharged industrial waste water and agriculture. A few countries also assess the contribution from less significant types of point sources and diffuse sources. This probably reflects that the concern is concentrated on the sources that contribute a major proportion of the total pollution.

Table 5: Source types included in registers (Numbers indicates number of countries)

UWW		IWW	Diffuse		Source apportionment	
Wastewater treatment plants	16	Generally all branches of industry relevant to the country	Agriculture	9	UWW	10
Untreated waste water	8		Scattered dwellings	7	IWW	10
Stormwater effluents	4		Background	4	Fish farms	6
Scattered dwellings	5		Forestry	5	Scattered dwelllings	5
			Atmosph. depos.(water)	6	Tributaries	6
			Atmosph. depos.(land)	5	Agriculture	8
					Forestry	5
					Background	8
					Retention	4

3.4.3. Calculation methods

Point source discharges from UWW and IWW are most commonly estimated by direct sampling. Sampling frequency usually varies from plant to plant depending on the

size of the plant or industry, the strategy generally being to estimate pollution from the largest polluters most precisely and reliably. For smaller plants more pragmatic methods (low sampling frequency, coefficients) are often applied, which is quite reasonable from a cost-benefit point of view. The pollution load from industrial plants is in some countries (e.g. France, Portugal) assessed by means of model calculations using detailed information of processes within each factory. There are both advantages and disadvantages with such methods. They are more complex and the reliability depends very much on the quality of the input data. That is, if input data and process modelling is not optimal, they may give poorer data than more simple methods.

Statistics on land-use (e.g. CORINE Land Cover), agricultural practice (national census) and other descriptors of diffuse pollution pressure are commonly available. The use of such information in the calculation of diffuse pollution load is usually by means of coefficients. The coefficients are usually calibrated by means of data from small homogeneous catchments. Further estimates of pollution load can be made using a mass-balance approach on a river basin scale. Subtracting the known discharges from the measured transport in the river provides an estimate of the residual pollution load. The methods are summarised in Table 6.

These methods are primarily applied to nutrients. The principle is basically simple and is applicable in many rivers, at least in its most reduced version only including UWW, IWW and residual load. The quality and informative value of the method is improved by inclusion of more pollution sources and an estimate of the retention in the river watershed.

Table 6: Source apportionment methods

Country	Directly measured	Calculated by coefficients, based on the descriptors in parentheses	Residual
Denmark	UWW, IWW, Total river transport	Atmospheric deposition (lake area), only for lakes Unmeasured tributaries Scattered dwellings (population) Retention (lake area in watershed) Background (area)	Agriculture
Finland (coastal rivers)	UWW, IWW, Total river transport	Background (area) Forest (area)	Agriculture
Netherlands	Large (industrial) point sources	Small/medium point sources, diffuse sources. NOT the actual discharge to water, e.g. urban emissions are emissions to the SEWER system.	
Norway	UWW, IWW	Open land, 6 land-use categories (area) Retention (residence time of each lake)	
Sweden	UWW,IWW	Atmospheric deposition on lakes, scattered dwellings, forestry, agriculture, retention	Nature
Switzerland	UWW, IWW	Agriculture, Atmospheric deposition on land and water surface, background run-off	
France	UWW, IWW.	Municipal raw emission, Industrial raw emissions (coefficients standardised against measurements), scattered dwellings, agricultural inputs (N, P).computed by model (development further the review)..	
Germany	UWW, IWW, Total river transport	Background load, diffuse load (emission method)	

Source: VKI et al., 1997

3.4.4. Examples of existing registers

A few countries produce and publish emissions registers. These registers could represent a major source of data for the European WEI. The following examples, which do not represent a comprehensive evaluation, are intended to illustrate the different kinds of information currently available, and help understanding which experiences can be useful for the development of a European WEI.

The Netherlands

The Dutch Government publishes regularly a report *"Emissions data for the Netherlands"* which summarises the results of the Dutch emission inventory for a given year. The results are analysed with respect to pollutant, economic sector, and aggregated location. The data collection system is based on a nested approach:

Individual Emission Inventory (700-800 major facilities), restricted data; emission estimates are the result of measurements. It addresses industrial sites only.

Collective Emission Inventory system, where emissions are based on statistical data and emission factors. This system is a GIS system, which operates on a 500 x 500 m grid. It encompasses urban sources, other industries, transport, agriculture and nature emissions.

France

The following registers are currently published:

The largest industrial facilities must report all emissions exceeding a certain threshold value. This concerns about 1600 facilities. A set of 23 substances are reported for water, and 13 for air. Data are disseminated through a report which is publicly available. Data originate from measurements carried out by the owner of the facility, and are validated by the Ministry of Industry.

Municipalities with over 10 000 habitants (2000 since 1996), report their emissions individually. A report on individual data is public. Data comes from UWW facilities and Water Agency measurements. Raw emissions (sewage entering a plant) are computed with coefficients, whilst net emissions (outlet from plant) are computed using emission monitoring.

All industries considered by the water agencies([1]) are reported on a statistical basis, aggregated per substance, per territorial unit (NUTS 3) and per branch.

3.5. Problems identified

There is substantial information available on emissions to water in Europe. However, the information is not sufficiently consistent and comparable between countries.

This arises from the following situations:

- Lack of common nomenclature of sources, substances and geographical location.
- Lack of common objectives, the currently available data registers reflecting different objectives and fields of investigation.
- Methodological difficulties. Many emissions to water cannot be measured directly. For example, pollution transferred by sewers in large cities, diffuse pollution from agriculture, leachates from railway tracks, etc.

[1] The rule for inclusion is quite complex. Summarised, all sites whose total emissions results in a fee greater or equal to the fee produced by a 400 inhabitants municipality, are included.

4. METHODOLOGY TO ESTIMATE EMISSIONS INTO WATER

4.1. Proposal for description of sources of emissions

Data can be split into the two major source categories:

Point sources

The main feature is that these sources can be located geographically very specifically, on the level of individual plants and installations/processes within these plants. The emissions can be obtained in different ways: direct measurement, mass balance calculations, other estimates. Point sources may be either large or small.

Area sources or "diffuse" sources

The main feature of these sources is that they cannot be located individually. This may result from a specificity of the source (e.g. leakage from land) or from lack of detailed information, especially when the considered source occurs in large numbers of very small individual sources (e.g. small metal plating workshops inside a large city).

These sources are therefore often called "diffuse" or " non-point ". In the CORINAIR terminology these sources are called "area sources". Examples are road transport, agriculture, small and medium sized enterprises. The emissions in these cases can only be obtained in indirect ways. A well established method for air emission inventories is the use of statistical activity data describing an emission generating activity (e.g. energy consumption or vehicle kilometres driven) multiplied with an emission factor (e.g. g/GJ). This method is frequently used for emissions to water as well.

There is a need to agree an appropriate level of aggregation taking into account two issues:

- The objectives of the inventory
- The ability to prepare data.

The following examples will illustrate the need for choices:

Municipal gross emissions (to treatment plant) can be estimated using either:

- Overall emission factor applied to the total population. This yields rough estimates but requires only population number, which is readily available. Emission factors are derived and expressed as daily or yearly PE loadings.

or:

- Selected emission factor applied to population, yielding only the domestic part of the emission. Services are accounted for separately and the major industries using the sewerage facilities are inventoried separately. The population and service parts can be estimated using overall emission factors, whilst industries may be inventoried using their branch-specific (or more precise) emission factors. Different levels of aggregation will be possible using this approach.

The capability of countries to provide data at the level for which emission assessment can be carried out is a key issue. As previous studies have not given this information, a flexible approach to data handling and database design must be envisaged. Further, the database and calculation system should facilitate cross-checking of the results.

Therefore it is suggested to compute separately the gross emissions (produced) and the net emissions (actually released to recipient water body after waste water treatment). The calculation of net emissions is essential when determining the relationship between pressure and state in the DPSIR framework

4.2. Geographical coverage and resolution

Both geographical area, such as watershed limits, and administrative units are required for computing and reporting. Particularly in small catchments there may be discrepancies between administrative and hydrological regions (see section 3.3.4.). Different methods for data collection and data calculation are used in different countries.

The GIS-based Dutch system consists of geographical intersections between grids (500 x 500 m), communities (administrative) and basic watershed areas (typical area 0,1 km^2). All activity data in the system are made available on this basic level. Calculation of the emissions within each area is based partly on monitoring data (large point sources) and partly on activity (inhabitants, area, production etc.) coefficients. The basic watershed areas can be aggregated to intermediate watershed areas and finally to large rivers like the Rhine and Meuse. The system is partly based on gross emissions (to the sewer system). For media-oriented purposes calculations should be based on net emissions (to the river/lake), although some information may be lost this way, e.g. it is difficult to divide the discharge from a municipal waste water treatment plant into contributions from households, industry and trade.

A newly developed French system connects point sources with catchments and diffuse sources with administrative units. Subsequently the emissions from diffuse sources at administrative level are distributed to catchments. Data can be aggregated to larger catchments or entire rivers.

Most countries use less comprehensive systems and the calculation of emissions to a body of water is done by simpler methods (see section 3.4.3.).

For further details on the Dutch and French systems see Annex II.

4.3. Current options for the european water emission inventory

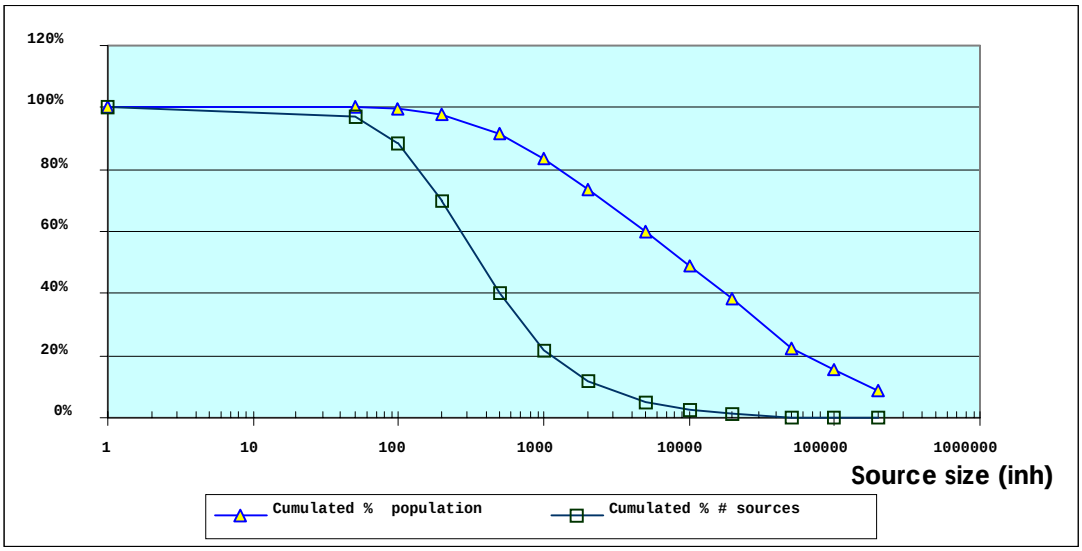
4.3.1. Differentiation of sources based on their relative importance

The number of individual sources is extremely high. In the Netherlands, there are about 40 000 industrial companies, of which 730 are included in the Individual Emission Inventory.

In France there are about 25 000 industrial emitters inventoried by the Water Agencies, of which 11 000 pollute by less than 400 PE. Among the remaining emitters, 27% of the total load came from the 100 largest sites, and 74% from the 1700 largest sites.

Similar figures are observed in UK, where the largest treatment plants (>15 000 PE) comprise a very high proportion of the total load (e.g., 91% of the total population) and thus gives much information with limited effort.

Figure 1: Proportion of population vs the number of municipalities (France, 1994)



In the whole of Europe, an individual approach would imply an enormous number of industrial companies and municipal waste water discharges. The cost and effort of this approach is disproportionate to the expected benefit.

The level of detail determines the codification of the sources, whilst the number of sources determines the effort of data collection.

Care must be taken that large sources receive special attention, which means to analyse them at individual level. If they are analysed and described at aggregated level, serious mistakes may occur. On the contrary, analysing small sources at individual level represents excessive effort, without improving the quality of the overall estimate.

It is recommended to inventory individually all point sources larger than 10 000 PE.

4.3.2. Source oriented (point and diffuse)

Point sources

Any point source (industrial or urban wastewater) can be analysed as:

- An activity, which produces pollutants according to its activity volume, and the set of processes involved. Calculation of the gross emission (GE) comes from [Emission Factor] × [Activity value]=GE.
- A transfer and purification device, which may significantly lower the actual emission. The resulting net emission (NE) comes from:

  NE=GE × TF × (1-PF), where TF and PF are respectively the Transfer Factor and Purification Factor. These later factors depend on the type and operation efficiency of the sewer system and waste water treatment plant.

It is important to bear in mind that the time scale of activity value, emission factor, transfer factor and purification factors are not the same. They must therefore be handled separately and updated from time to time.

Pilot projects should clarify the different values of practical and representative coefficients, and in which domains they are to be used.

The data system should address separately the activities, the transfer factors and the purification factors. In practice, the information requested should include the activities and the IWWTP and UWWTP as well. Smaller sources could be treated with the same method, but the data could be aggregated before treatment.

Applying the "size x effort" relationship, the method for the inventory should:

- Deal with large sources, apply to them the ad hoc nomenclature and compute their load contribution. In the first steps, the data handling system should treat computed and survey data.
- Aggregate smaller sources, applying to these a simplified nomenclature and compute their overall contribution.

A prerequisite of this inventory is the accurate understanding of the methods which are currently used by countries to compute their domestic registers. Otherwise the emission load reported may differ from country to country, e.g. net emission vs. gross emission.

There will be a need to harmonise the methods. Common methods should as far as possible use data already existing. This in turn implies a relatively simplified approach, which is in line with the cost-benefit considerations above (compare the presentation of simpler and detailed methodologies in the Air Emissions Inventory Guidebook (EEA, 1996)).

Diffuse sources

- For agricultural areas, the nutrient surplus is the base for calculating gross emissions, but the possibility to derive net emissions from such data is questionable. The assessment of agricultural emissions from a limited set of coefficients calibrated in small catchments seems far easier. For that purpose, the agricultural area must be classified (few classes, e.g. permanent grassland and arable land in rotation) according to crop types and soil type.
- A similar approach can be used for "nature" areas, scattered dwellings etc.

The simplified approaches do not relate driving forces (agricultural activity) to pressure (emissions) if survey derived global coefficients are used. That is why, despite the difficulties, another method is recommended for assessing the most common agricultural sources, for which the diffuse pollution can be calculated by models that aim at evaluating the available surplus. The currently available models are designed to use national agricultural statistics as inputs.

All models reviewed (France, Ireland, Belgium, Denmark, United Kingdom, Sweden, the Netherlands, Germany, Austria, see references) are based on the same general principles, but may differ much in detail.

The nitrogen release rate is a function of the surplus. The surplus may be either computed from overall balances, or monitored as the quantity remaining in the soil after harvest. A positive relationship involving this surplus has been demonstrated in several countries (last reference indicated in appendix). Therefore, a correct assessment of surplus should be aimed at. Final leaching can be related to soil loads, using pilot catchments.

The load to soils may be calculated as density or pressure. In the approach made in France, density loading is distinguished from pressure loading on the impact criteria. A density load is defined as the load divided by the overall area([2]). A comparable calculation is when an average surplus of 20 kg N ha^{-1} y^{-1} is reported (Poiret, in Anon. 1997). This figure comes from 546 000 tonnes N surplus divided by the French agricultural area.

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[2] For instance, population density is the total population divided by the state area, and yields, in France 100 inh./km^2. If considering that population lives in towns, the pressure load is much higher, in the range 1000 to 10 000 (average 1500) inh/km^2, which dramatically changes the actual pressure and possible emissions. This last value should be preferred for pollution assessment

Pressure loads can be computed allocating the input of fertiliser to the agricultural area where it is most likely to be applied. Using a deconvolution technique based on CORINE Land Cover (unpublished, under validation), local N surplus may be in the range 400 to -100 kg N ha^{-1} y^{-1}. These values could yield totally different water discharge patterns than those computed from density loads.

Efforts should be undertaken to harmonise and combine the presently available data and dis-aggregate the results at the watershed scale.

For calculation of diffuse pollution at the European watershed scale, CORINE LC should be the basic layer. It has the advantage of being the only common layer of land use types defined with a common nomenclature.

Surplus models could also use the CORINE LC layer and simple coefficients to provide rough estimates of emission loads. As far as possible, local practices should be taken into account.

Model estimates should be verified against mass-balance and flux assessments.

4.3.3. Specification of the required data

It is not in the scope of this initial report to specify the data to be provided by countries. The data needed for description of individual point sources are the following:

Industrial sources (PER of the IPPC directive)

The data that will be required to be reported by the Member States to the Commission are not yet decided and are being discussed within the IPPC article 19 Committee and its two working groups.

Information within the following categories should be reported:

- name and address of the source;
- contact person (name, tel. number etc.);
- location of the source (latitude, longitude)
- economic source code (NACE), combined with one or more technological codes (to identify major technological sources within one reporting facility, e.g. separating the process/production from non-process activities);
- name, code and definition (if not available in substance nomenclature) of each substance considered in the release (if specific substance, e.g., halogenated compounds, if possible its CAS number or other relevant code and nomenclature);
- activity volume and local emission factor (if any) and monitored emissions data into water per year, possibly indicating the duration of releases (e.g., for seasonal activities), possibly split into different technological source sectors.
- waste generated and disposal, either to self treatment or to municipal disposal or treatment facilities; name of the receiving water body if far from the facility site;

Municipal sources

The data indicated below are a first attempt to specify data required from municipal sources. It is not yet possible to derive definite data, since the final methodology has not been described, nor the data availability fully checked. The currently available reports do not provide such level of detail that this list can be made.

- GIS on main cities, and administrative boundaries;
- Population census, broken down by lowest administrative unit;
- Equipment of cities in sewer and UWWTP. A preliminary limit of 5000 to 15 000 inhabitants (example value, to be adjusted according to available information) could be used for computing individually or by aggregation the municipal contribution.

Agricultural data

The main data are those useful to compute surplus models and transfer.

- Soil type information;
- Land-cover data, e.g. CORINE LC;
- Agricultural statistics on crop types, fertiliser consumption, harvest and crop yields. These data exists as national agricultural census, the spatial resolution of the census must be carefully considered;
- Climatic data, especially those in relation with nutrient leaching.

Most of this data is available in European or national databases. However, the spatial resolution may not be satisfactory. Some information is only available at national level. It may be used to assess the gross emissions (surplus) at national or regional scale, but is insufficient for assessment of net emissions to water in small catchments.

Watershed data

The recently created GIS river and catchment database (prepared for the EEA) should be used for aggregation at watershed level.

4.3.4. Need for relevant time resolution

Emissions to water follow very different patterns which are reflected in the variations of concentration in the receiving water bodies. Moreover, the time scale for emissions directly depends on the final use of data and sensitivity of the recipient.

In most cases, emissions are collected on a calendar year basis. This time span is usually suitable for still water bodies or groundwater, though it may be insufficient in areas with heavy seasonal fluctuations such as in tourist areas.

In the case of rivers, the pressure is very dependent on the hydrological regime, which is evaluated at the hydrological year scale (from end of a low water yearly period to the next one).

From a media-oriented point of view it would be valuable to know the main seasonal variation. A reasonable compromise is to construct a system that yields annual values, and pinpoints the significant seasonal releases, their period and duration, only for those emissions which have high seasonal discharge patterns, and no efficient storage facility.

4.4. Aggregation of data for relational database for estimation and reporting

The physical basis of the European WEI should be a relational database system arranged by:

1. **source:** (individual, group, installation, plant, facility), the structure of sources may be by itself a relational system;
2. **substance or aggregated substances:** the table of substances must be unique for all emissions;
3. **medium of release:** (air, water, land disposal, underground injection and off-site) and by year. It is obvious that this can only by done through a relational database. For the description of sources of emissions, extended information at different level should be collected and stored as needed;
4. **geographical scope**: (administrative and watershed).

The database structure is not defined at the present moment. Thus, the design of software will be possible only when the main conclusions about the inventory structure are finalised. Software should have two functions, which are not necessarily available in a single package:

- Store and report data that have been gathered by countries fulfilling the European definitions.
- Generate, store and report data for countries that do not have an inventory fulfilling the European definition.

During the preparation of this report, two existing systems have been considered None of these fulfil all requirements but both provide some interesting features.

French and Dutch experience on developing and operating software suggest that such development requires many man-years of effort and is very expensive.

A very important step will be to select and customise ad hoc software facilities, which could come from the merging of existing programmes, in order to reduce development costs.

The CollectER software recently developed by ETC/AE for national inventories of emissions to air and distributed to all EEA countries in June 1998 may form the basis for such national and European systems.

4.5. Need for validation of emission factors

Emission factors (including technical coefficients) utilised in point and non-point source assessment and modelling, are very variable from one country to another.

The differences in numerical values may represent:

- A basic difference in concept, that is to say a difference in the nomenclature used.
- A real difference in the emission factor, due to structural reasons.

The technical coefficients shows major differences as shown in table 7. The reasons for these differences need to be elucidated.

Table 7: Emission factors used by different countries, data compiled by EUROSTAT. Figures are in kg nitrogen per item and per year.

Country / item	IR	UK	NL	FR	SW	BE/W	BE/F	DK
Bovine, less than 1 year		17.3		21.9		14.0	33.5	
Piglets, less than 20 kg	0.7	4.4		4.6	2.3		3.2	0.3
Breeding female rabbits			7.6	3.2			0.2	

5. CONCLUSIONS AND RECOMMENDATIONS FOR EMISSIONS INVENTORY DESIGN

The difficulties in assessing emissions to water, due to the multiple methods of approach and the lack of homogeneous data, indicate that a pragmatic approach be taken and that the construction of a Water Emissions Inventory at the European level should be attempted on a step by step basis. This should focus on a limited set of highest priority determinands which can be evaluated by simple means and not require too much data.

The main principle is to achieve good precision for individual large sources, and a lower precision for aggregated small sources. Therefore, it needs to combine inventories and statistical assessments in a similar way to that carried out for air emissions in the CORINAIR system (see EMEP/CORINAIR Atmospheric Emission Inventory Guidebook (EEA, 1996)).

The nomenclatures and data that are needed by the model must be carefully listed and evaluated, particularly the capacity of data providers to apply the nomenclatures to their national data sets. The main issues requiring specific attention are:

- Finalisation of a comprehensive source nomenclature. The NOSE nomenclature could constitute the basis for that task.
- Availability of a common GIS that is capable of dealing with administrative and watershed aggregations. This will require liaison with the EEA and Eurostat (GISCO), who are both holding useful datasets.
- Choice of a common agricultural load assessment method to differentiate the surplus loads.
- Transfer (from source to waterbody) assessment methods need to be developed, and calibrated. There are a number of available methods which could be considered for suitability.
- Reporting of emissions into water for legal requirements such as PER/IPPC and the WFD.

For these purposes, pilot testing with volunteer countries (e.g. France, Denmark, the Netherlands, to be confirmed) of the methodology and the model using readily available data is recommended.

This test should deal first with the determinands related to nutrient issues (eutrophication), which are common to urban, industrial and agricultural emissions, and are partly due to air-borne emissions and deposition of ammonia and NOx. Eutrophication is a general problem in most of Europe and for which there is considerable experience in the coupling of information on emissions and environmental state. The integration of emissions to air and soil may be difficult to establish, especially the transfer of substances from air and soil to water, and the benefits should be clarified.

The EEA is increasing its capacity to carry out integrated assessments of specific problems and this initiative would support current and future activities in this area by providing a systematic approach to gathering catchment pressure information.

A proposed list of determinands (the “base set”) to be included in the first approach to producing a European Water Emission Inventory is as follows: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Phosphorus, Total Oxidised Nitrogen and Ammonia. It is further proposed that heavy metals (Cu, Hg, Cd, Pb, Ni, Cr, Zn, and As), PAHs and other “Dangerous Substances” should be added later.

Moreover, the European WEI system should be approached in a modular way, so that the necessary improvements of the nomenclatures are carried out in parallel with the implementation of the first modules and the development of a guidebook.

This twin approach is essential to ensure long term accuracy and short term relevance.

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Expanded meaning
ETC/AE	European Topic Centre / Air Emissions
ETC/IW	European Topic Centre / Inland Waters
ETC/W	European Topic Centre / Waste
IEI	Integrated Emissions Inventory
NOSE	Nomenclature Of Sources of Emissions
PER	Polluting Emissions Register
POP	Persistent Organic Pollutant
CAS	Chemical Abstract System
NACE	Nomenclature générale des Activités économiques dans la Communauté Européenne
TEF	Tableau d'Estimation Forfaitaire
SNAP	Selected Nomenclature for sources of Air Pollution
UWWTP	Urban Waste Water Treatment Plant
IWWTP	Industrial Waste Water Treatment Plant

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ANNEX I - DETAILS ON NOMENCLATURES

The NACE nomenclature

The EU standard statistical nomenclature for economic activities (NACE) is a necessary component of a source nomenclature. Any economically active entity can be assigned to a NACE category, and since NACE is also the basis for economic statistics, emissions data can be aggregated in ways which correspond to economic data. However, NACE is not by itself sufficient to identify sources at the level of detail required for most inventories, for the following reasons:

- a NACE category will include multiple entities (enterprises, factories, households) which may need to be separately identified in an inventory. This is a fairly trivial question since individual entities may be identified by assigning a unique identification code. For enterprises (and local units of enterprises), a unique code would normally already exist in the national business register.
- an economically active entity (such as an enterprise) should always be classifiable in one NACE category (if necessary, following the principle of main activity), but will usually contain multiple emissions sources. These sources must be separately identifiable and capable of aggregation independently of NACE, in order to give emissions corresponding to source sectors such as "industrial combustion", or according to the emitted substance, such as “Zinc” or “Total phosphorus”.

Many attempts in the field of emission inventory have confirmed that the NACE cannot be used by itself to assess emissions. Indeed, emissions result from operations carried out with some physical device (machine, land, animal etc.). Each of these have a specific set of emission rates, for a specific list of substances. It is therefore likely that a full identification of sources will require at least a two-dimensional nomenclature:

[economic entity] × [emission-generating process] where

[economic entity] can be coded as [NACE code][unique identification code] and

[emission-generating process] means any process, operation or machine, which may be coded in different ways.

This approach is used in the NOSE nomenclature (see below).

The SNAP nomenclature

The SNAP (Selected Nomenclature for sources of Atmospheric Pollution) is currently used for preparing national air pollution inventories in Europe.

SNAP is maintained by ETC/AE in co-operation with the CLRTAP/EMEP Task Force on Emission Inventories.

SNAP classifies all main activities generating air pollution and define corresponding 6 digit codes. SNAP is described in the EMEP/CORINAIR Guidebook and address emitters of SO_2, NO_x, NMVOC, CH_4, NH_3, CO, CO_2, N_2O, heavy metals and POPs.

The French TEF nomenclature

The French Water Agencies have developed a nomenclature (TEF) to evaluate and charge for pollution to water. The TEF nomenclature is enforced by law and implemented on all significant emitters to water in France, totally about 14 000 industrial sites.

Around 370 polluting activities are currently covered and new ones may be added provided sufficient measurements are available. These activities are mainly industrial,

but services (specific collectivities), animal husbandry, mining and quarrying, etc. are included. A similar system is used for municipal releases, and it uses the same list of determinands which are the MO [(2*BOD_5+COD)/3], SS, Total P, Total reduced N, Total oxidised N, salts, Aromatic halogenated hydrocarbons (AOx), "METOX" (weighted sum of Hg, Pb, Ni, Zn, As, Cu, Cd) and toxic potential. Apart from N and P compounds, these determinands are pollution indicators or aggregates rather than individual substances. Partial recodification of the TEF, in the frame of the ACCOR project nomenclature (see below) has been undertaken.

For sites with a low activity inclusive emission ratios are used. For larger sites, emission values are derived from direct measurements carried out and computed with the activity figures collected on the site during the measurements.

All major sources are submitted to frequent surveys performed on a semi-voluntary basis. Data are collected by Water Agencies and by the Ministry of Industry. Co-ordination of efforts are made so that annual loads can be derived from these data. The individual results are not confidential.

The Dutch system

Nomenclature of Sources

The source categories of the National Environmental Policy Plan (NEPP) contain about ten social target groups: Refineries, Energy Sector, Industry, Traffic and Transport, Consumers, Agriculture, Waste Disposal, Other and Nature.

The technical source categories in the Emission Inventory contains about 1000 source groups including industrial processes which all are linked with the target groups.

Nomenclature of Substances

The NEPP contains about 170 so-called priority substances for which emission reduction goals are formulated.

In the basic (technical) substance list, about 900 individual substances and technical mixtures are identified. These technical substances are monitored in the inventory. Only the priority substances (of political and social interest) are reported. Of course there is a link maintained between the priority substances and the technical substances. In many cases the link is one to one, but also one to many and many to one and even fractional relations exist (for instance the benzene-content of mineral oil that is monitored as emitted substance). Next to the 170 priority substances the Dutch environmental policy has formulated 8 environmental themes wherein the main effects of the emissions are weighted. The themes are: Climate change, Acidification, Eutrophication, Dispersion of toxic substances, Disposal of solid waste, Disturbance of local environments, Dehydration of soils, and Squandering of resources. In the case of water emissions, three themes are accounted: Eutrophication, Dispersion of toxic substances and Acidification. Weighting factors for all priority substances are derived by Adriaanse (1993).

The Netherlands issue, every year, emission data for air and water. Emissions to water are clustered in four groups, which contain:

Eutrophying substances,

Metals and metalloids [Sb, As, Cd, Cr, Cu, Hg, Pb, Ni, Zn]

Organic compounds [non halogenated (aliphatic, aromatic: 9 substances), halogenated (aliphatic: 9 substances, aromatic: 6 substances)],

Other [(Cl, CN, F) and pesticides, 4 substances].

NOSE and ACCOR integrated nomenclatures.

The NOSE project provides a classification for emissions sources which is linked directly to NACE, the European counterpart of the international ISIC classification of economic activities. A detailed description is in SEPA, 1997. The project is an ongoing development process.

All sources of emission to air in the current NOSE-P list in the NOSE manual are directly taken from the SNAP nomenclature, but rearranged to be more consistent with NACE. The current list of sources of water emission in NOSE-P is based on limited national and international experiences and in particular this list will be further developed and/or simplified in the framework if the IPPC/PER developments.

The ACCOR nomenclature project comes from the observation that the NAPSEA nomenclature, developed for air emissions but never completed or used, is not suitable for extension to other media.

However, the experience obtained during the partial application of NAPSEA has been used by the CITEPA to merge the economic and the technical aspects of the existing nomenclatures.

ACCOR principle is the combination of two items, the first indicating the economic sector, the second the set of processes that are involved. There is no hierarchical relationship between both members, since an economic activity may use very different processes, conversely, a given process can be involved in several economic activities.

This relative independence permits the construction of rather compact activity tables.

The syntax of any ACCOR code is the following:

The **economic sector**, described by an 8 digit code which may be either the NACE code, the PRODCOM code whenever possible, or the CAS number of the chemical produced.

The **operation** required. Ten possible types are described. The type is independent of the device used to carry out the operation. For instance, type 3 “Biological transformation” may be done in the field (the device is an animal), or in a fermenter (the device is a fix facility).

The operation in carried out in, with, inside, etc. a **device**. Provisional codification of devices has been carried out. At the present moment, no final classification has been found satisfactory. Investigations are made to evaluate the possibility to use the KOMPASS classification instead of a “home-made” classification.

The **input products**, with which or from which the operation is carried out. At present, most input products codified are chemicals.

It is necessary to develop the ACCOR further to make it useful in a European Water Emission Inventory context, particularly considering the practical capabilities of data providers to codify their national activities in this rather detailed system. The capabilities to cope with a simplified approach, to be later expanded, is essential in this respect.

ANNEX II - GEOGRAPHICAL COVERAGE

The Dutch approach

The geographical base units consist of geographical intersections between grids (500 x 500 m), communities (administrative) and basic watershed areas (typical area 0,1 km^2), managed by means of a GIS-system. All activity data in the system are made available on this basic level. The basic watershed areas can be aggregated to intermediate watershed areas (called (PAWN-)districts) and finally are part of stream areas of large rivers like the Rhine and the Meuse.

Besides the basic watersheds the system contains small surface waters which are part of the (basic) watersheds.

The large rivers are also divided into sections (called nodes) that allow division of water masses in different directions.

Emissions are divided into: emissions that directly result in environmental load and, emissions that indirectly cause environmental load. Care has been taken that there is no double accounting of emissions causing direct environmental load. Next to this all emissions to water are attributed per basic watershed. The main outlets of individual industrial measured companies (about 1200) are put exactly on the watershed while for smaller companies an estimation is made based on the layout of water purification areas (the latter term is not used in the Netherlands). All built-up (domestic and industrial) areas with sewer systems in the country are put on maps and the destination of the sewer systems to specific water purification plants or a surface water is established. An estimation is also made of the percentage of buildings that are connected to sewer. So a water purification area can be seen as the area of the map where sewage is treated by one specific water purification plant. The destination (surface waters) of the effluents (which are mainly measured) of water purification plants are also part of the system. The emissions of diffuse sources outside built-up areas which are estimated with activity data and emission factors or sometimes with models (e.g. agriculture) are put on the basic watershed. Emissions of diffuse sources inside built-up areas, which are estimated with activity data and emission factors, are put on the sewage system.

This results in a inventory system where emissions and environmental loads are available on distinct administrative and technical levels:

- Administrative: Communities, Provinces (aggregation of communities), Waterboard authorities (aggregation of basic watersheds), Country
- Technical: Basic watersheds, Districts, River stream areas

The French approach

The method used in the French Integrated Inventory (which is underway) is to use different methods for computing and aggregating data.

1. Direct releases to river system are attributed to the elementary reach in the French national river classification system (CARTHAGE). Large sites outlet are identified separately, whilst unregistered small outlets are set to the closest reach.
2. Diffuse sources are calculated from agricultural census, which is at administrative level, and values broken down to the elementary “entity”, defined as the intersection of the commune (NUTS 5, 36 000 units) to the smallest catchment described in the CARTHAGE system (6300 units). The deconvolution method involves the uses of the CORINE Land Cover layer.

This method is neutral considering the possibility of aggregation at any level, administrative or watershed. Since the basic units are used, there is no approximation error when aggregating at large scale.

All methods are closely linked to the available statistics, principally those recorded by the Ministry of Industry (large industrial sites, registered according to IPPC recommendations), all industries and municipalities (recorded by the water agencies), and agricultural data (based on statistics and census collected by the Ministry of Agriculture).

Homogenisation of data and modelling is carried out by Ifen, as Statistical Office of the Ministry of the Environment.