Part D CURRENT AND FUTURE POLICIES AND REGULATORY FRAMEWORK

Charlotte Hagner[1] (GKSS) and Carolin Peters[2] (TU-HH)

1 Introduction

Due to its location of the port of Rotterdam in the estuary, the Rotterdam Municipal Port Management has to deal with contamination of sediments, which is on the one hand caused by their own country as well as upper riparian countries, like Germany. On the other hand disposal of dredged material in the North Sea is a subject of several international conventions and agreements.

The overall aim of this part of the project is to give an overview over current and future Dutch, German, European and international regulations concerning[1]:

1. water and sediment quality targets for rivers, especially the Rhine, and for the North Sea (immission approach);
2. emission control, which influences directly or indirectly the sediment quality of the Rhine; and
3. dredged material management.

Because the port of Rotterdam is the 'interface' between the Rhine and the North Sea, a complex interplay of regulations, directly or indirectly of concern to the disposal of dredged material, has to be taken into account. On the one hand one has to deal with regulations, which influence the quality of sediments/dredged material, and on the other hand with regulations, which concern the disposal of dredged material itself. This complex system of the national Dutch and German, European and international regulations concerning the immission and emission approach as well as the dredged material management is summarised in figure 1-1.

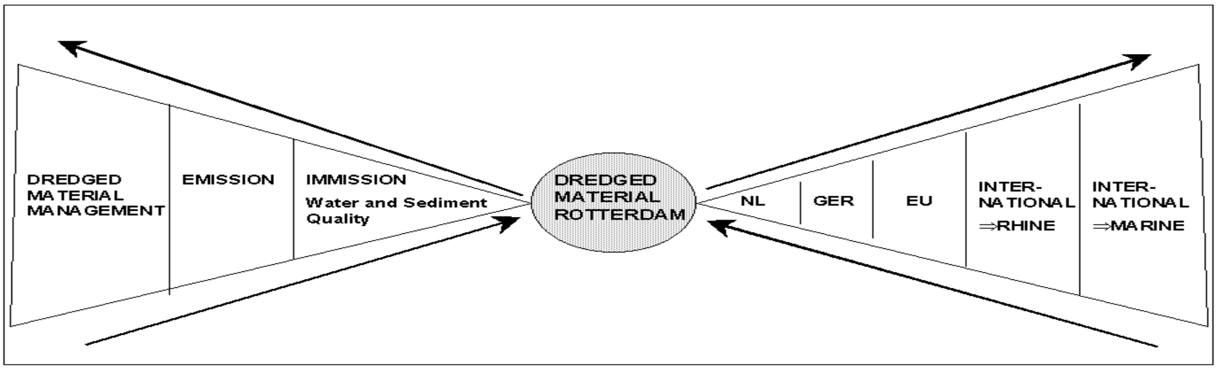


Figure 1-1: Overview over the interactions of national and international regulations

Countries like the Netherlands and Germany are Member States of the European Union as well contracting parties of the International Rhine Commission (ICPR, Rhine catchment area) and conventions as the OSLO and Paris Convention (OSPARCON) concerning the receiving coastal environment (North Sea). They therefore are directly involved in setting up guidelines

[1] The overview on national regulations focuses on the Netherlands and Germany for two reasons: (i) Dutch regulations with respect to dredged material are of direct concern, (ii) both riparian countries, the Netherlands and Germany, together constitute 79% of the Rhine catchment area and 86% of the population in the catchment area.

and regulatory frameworks on the EU and international level, which then have an impact on the national policies and regulatory frameworks.

On the different levels there are three major aspects: Emission control and the immission approach (quality targets) have a direct impact on the quality of sediments in the Rhine catchment area including the port of Rotterdam whereas guidelines for dredged material management on the international level (e.g. OSPARCON) set up a framework and give recommendations for the implementation of regulations concerning dredged material management on the national level.

The examination of the current and future policies and regulatory framework will be done by two bottom-up approaches, reflected by the main chapters and their substructure, followed by an overview on 'regulations and experiences from European harbours' (figure 1-2).

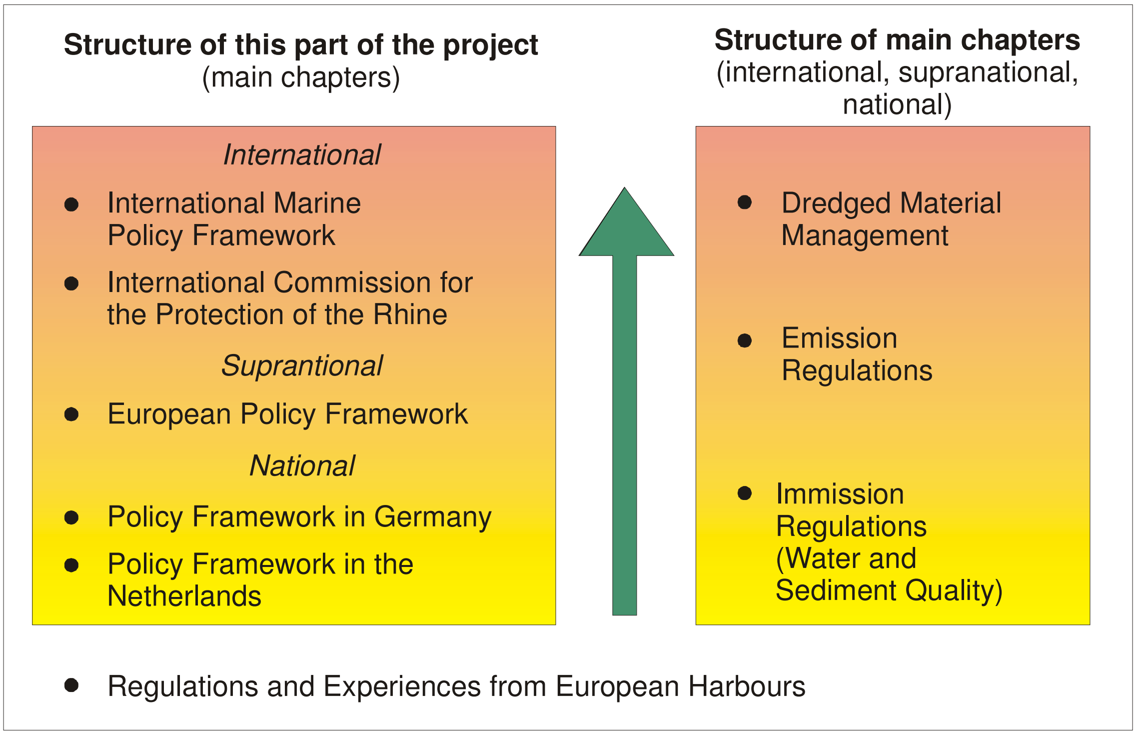


Figure 1-2: The structure of 'Current and Future Policies and Regulatory Framework'

First of all (left part of figure 1-2), the Dutch policy and regulatory framework, which directly influences the dredged material management in Rotterdam will be analysed. Because Germany covers 64% of the River Rhine catchment area, the German regulations, which influence the sediment quality are of importance. Further, both countries are member states of the European Union, so that supranational regulations will be examined afterwards. Finally (on the top), the discussion will focus on relevant international conventions and agreements. Among others these are the International Commission for the Protection of the Rhine (ICPR, e.g. sediment quality targets, action plans incl. reduction targets for emissions) with regard to the Rhine catchment area and the Oslo and Paris Convention (OSPARCON) concerning the receiving coastal environment.

The substructure of each main chapter again follows a bottom-up approach (right part in figure 1-2). With respect to the pollution path, pollution can be controlled by setting immission (environmental quality) standards at the environmental effect level (immission principle, immission approach), and/or by establishing standards at the source (emission principle, emission approach). Sediments as a resource are generally objects of protection, following the immission approach. Both, emission control and the immission approach, have an impact on the quality of sediments in the river catchment area and related dredged material.

In the following chapters the discussion will focus on regulations for those substances, which are priority substances in the case of dredged material management in the port of Rotterdam, namely metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

Because concerning the immission principle a confusing mixture of terms are applied, relevant terms will be defined as follows. The term 'quality targets' refers to scientifically based guide values (e.g. for water and sediment), which are not legally binding. But 'quality objectives', 'quality standards', 'quality criteria' and 'immission standards' in a more general meaning are legally binding.

2 The national policy framework in the Netherlands

To maintain adequate port facilities, 20 million cubic metres of sediments were removed in 1998 from the Rotterdam port area by maintenance dredging. The dredging activities are conducted by both the Rotterdam Municipal Port Management (RMPM) in the ports and by Rijkswaterstaat Directorate South-Holland (RWS-ZH) of the Ministry of Transport, Public Works and Water Management in the waterways and access channels. The disposal options for the material depend on its environmental quality as established during the yearly sampling campaigns. In 1998, the majority of this amount of material was relocated to the so-called Loswal Noord site in the North Sea. However, 3 million cubic meters of dredged material (including material offered by external authorities) was too polluted for this purpose, and therefore was sent to the Slufter depot for storage, and possible processing by sand separation and clay formation (RMPM, 1999 & 2000).

This chapter deals with the Dutch policy and regulatory framework for the disposal of material from maintenance dredging operations in estuarine harbour area's, with a focus on the port of Rotterdam. Dredged material from this area is called estuarine dredged material *(zoute baggerspecie)*. According to Dutch policy requirements, estuarine dredged material should be returned to the marine environment as much as possible, provided that it is 'clean', which requires an assessment.

In chapter 2.1 the general Dutch water management framework is discussed. Aspects related to the quality of dredged material, including quality targets for water and sediment (immissions) are discussed in chapter 2.2, followed by emission reduction targets and accompanying measures in chapter 2.3. The present and future policy and regulations for dredged material disposal in the marine environment are presented in chapter 2.4.

2.1 General water management framework

2.1.1 Institutional structure

The Dutch institutional structure for water management includes three governing levels: national, provincial and regional/local.

The central Government formulates the main lines for strategic policies on water issues at the national level. The central Government is also responsible for the operational management of the state-controlled waters and some major flood protection works.

Three ministries have important tasks. The Ministry of Transport, Public Works and Water Management (Min. V&W) is responsible for flood protection and general water management. The water directorate of this ministry, the Directorate General for Public Works and Water Management (*Rijkswaterstaat,* RWS), prepares national policy on these issues. This directorate also has the operational responsibilities for state-controlled waters, such as the major rivers, canals and the North Sea (which responsibility is delegated to the regional Directorates) and supervises the implementation of the water policy by provinces and local water authorities.

The Ministry of Housing, Spatial Planning and the Environment (Min. VROM) is responsible for general environmental policy development; setting of (water) quality targets and emission standards; laws concerning air, soil and groundwater protection, waste, noise, harmful substances, radiation; drinking water, sewage and spatial planning.

Finally, the Ministry of Agriculture, Nature Management and Fisheries (Min. LNV) is responsible for general policies on agriculture, nature management, fisheries, rural areas and outdoor recreation; legislative policy concerning nature conservation with regard to species and areas.

The provincial governments define their strategic policies for the non-state controlled waters and the regional framework for flood protection. The provinces also take care of the operational management of ground water extraction and in some cases of water courses serving navigation. The provinces have created the Association of Provinces (*Interprovinciaal Overleg*, IPO), in which common views and statements of the provinces are formulated.

The water boards and municipalities are responsible for the operational management and the actual implementation of policy issues. The water boards are responsible for local flood protection, and water quantity and quality management, including waste water treatment. They are united in the Association of Water Boards (*Unie van Waterschappen,* UvW). The water management task at municipal level is limited to the management of sewage systems, usually attributed to local public works departments or joint agencies. The municipalities promote their common views through the Netherlands Association of Municipalities (*Vereniging van Nederlandse Gemeenten*, VNG).

Figure 2-1 presents the three governing levels and their respective plans for water management and the related fields of environmental protection and spatial planning.

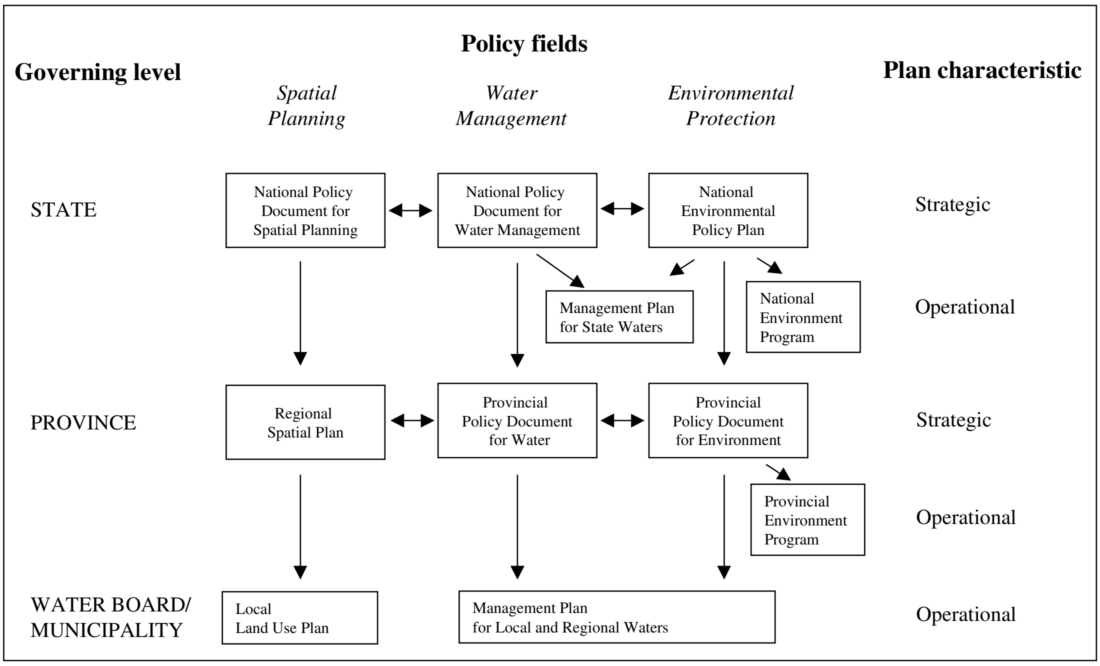


Figure 2-1: Water-related planning structure in the Netherlands (adopted from Huisman et al. 1998)

Strategic water policy plans (dealing, amongst others, with immissions, emissions and dredged material management) are the Third National Policy Document on Water Management NW3 (Min. V&W, 1989), the Water Policy Evaluation Document ENW (Min. V&W, 1994) and the Fourth National Policy Document on Water Management NW4 (planning period 1998 – 2006) (Min. V&W, 1998). The policy proposals mentioned in these documents are elaborated in operational management plans. Every four years a national management plan for the state-controlled waters is issued by the ministers of V&W and VROM, the most recent one being the

Management Plan for the State waters 2 (planning period 1996 - 2000) (Min. V&W, 1996). The Management Vision North Sea 2010 (Min. V&W et al., 1999) is an elaboration of the current policy for the North Sea. The policy and management plans are much based upon technical/scientific background studies, often prepared by the RWS knowledge centres, such as the National Institute for Inland Water Management and Waste Water Treatment (RIZA) and the National Institute for Coastal and Marine Management (RIKZ). The province of South-Holland is the relevant provincial structure for the present project. For the period 2000 – 2004, the province has issued an integrated strategic/operational plan for water and the environment (Prov. Zuid-Holland, 1999). Relevant regional institutional structures are the municipality of Rotterdam and various water boards (Hoogheemraadschappen Delfland & Schieland, Zuiveringsschap Hollandse Eilanden & Waarden, Waterschap Ijsselmonde), which prepare local operational plans, like the forthcoming Waterplan Rotterdam (Gemeente Rotterdam et al., 2000).

2.1.2 Water legislation

Dutch water legislation is incorporated in various laws and regulations. Apart from the fundamental statement in the Constitution, there are laws directly aimed at water, which deal with the institutional framework and the organisational aspects, with aspects of (integrated water) policy, with aspects of infrastructure, drinking water, and finally there is legislation aimed indirectly at water. Water quality management has its basis in the Pollution of Surface Waters Act and the Seawater Pollution (see below). The Environmental Protection Act plays an important role in water management as well, for example via the Chapter waste water (Min. V&W, 1996; Huisman et al., 1998). Below a short overview of the main relevant Acts can be found.

The Water Administration Act *(Waterstaatswet)* (1900) deals (amongst others) with the organisation, tasks and competencies of the Directorate General for Public Works and Water Management.

The Water Management Act *(Wet op de waterhuishouding)* (1989) defines the planning structure for water management by the Government agencies at different levels and gives rules for the quantitative management of surface waters. The planning structure of this Act presents an integration of national and provincial plans based on the Pollution of Surface Waters Act, the Ground Water Act and the Water Management Act itself. It also includes statutory cross-references with spatial planning and environmental planning. The Water Management Act formulates the objectives and contents of the management plans and defines the updating of the plans every four to eight years.

The Pollution of Surface Waters Act *(Wet verontreiniging oppervlaktewateren; Wvo)* (1970) which main objective is the pollution control of all surface waters. The instruments of the act are: the setting of standards, the issue of discharge permits and the use of levies. It is forbidden to discharge into water, unless a permission is granted. There is a levy on discharges, especially of organic waste and heavy metals, which is used to recover the costs for wastewater purification. The act contains regulations for the management structure of water quality management. The primary permit-issuing authorities are the national Government or the provinces, which delegate their responsibilities to the regional RWS directorates or the local water authorities. In this act international agreements such as EU directives and the Rhine treaty have been incorporated.

The Seawater Pollution Act *(Wet verontreiniging zeewater; Wvz)* (1975) is an implementation of the Treaties of Oslo and London (1972) on the prevention of the pollution of the sea by the disposal of waste and other substances. For certain substances a discharge ban is in force, while the discharge of others is regulated via exemptions. The RWS - Directorate North Sea is the permit-issuing authority. Operational discharges by ships are regulated via the Act on the Prevention of Pollution by Ships.

The Act on the Prevention of Pollution by Ships *(Wet voorkoming verontreiniging door schepen; Wvvs)* (1983) is an implementation of the MARPOL treaty (1973) on the prevention of pollution by ships. The act knows a discharge ban, with exemption which are established in so-called general administrative orders *(Algemene Maatregel van Bestuur)*. Furthermore, the rules for harbour collection installations *(Haven Ontvangst Installatie; HOI)* are laid down in this act.

The Soil Protection Act *(Wet Bodem Bescherming; Wbb)* (1986) contains a general duty to prevent, and if necessary, to clean up soil and groundwater pollution. It distinguishes two levels of protection; a general level and a specific level. The general protection level is formed by regulatory measures set by the national government. These rules concern the regulation of activities that may lead to contamination or impairment of soil and groundwater, and the formulation of soil quality standards. A specific protection level must be implemented in soil protection and in groundwater protection area's used for water supply.

Legislation for issues related to water are the Town and Country Planning Act *(Wet op de ruimtelijke ordening)* (1962) and the Environmental Protection Act *(Wet milieubeheer, Wm)* (1992). The latter provides the legal framework for the environmental plan and programmes of the central government, the provinces and the municipalities and lays down the regulatory procedures for planning and permit granting. Via this act the environmental burden of institutions (industrial activities) is regulated. Sewage management is not regulated by formal legislation, but by provincial and municipal ordinances. In the Environmental Protection Act an obligation is put on the municipalities to prepare local sewage plans.

In the context of the present project, the Dutch Building Materials Decree *(Bouwstoffenbesluit)* should be mentioned as well. This general administrative order, based upon the Wvo and Wbb, is in use since January 1999 and has the primary goal to set the environmental conditions for the responsible use of primary and secondary building materials on land or in water systems. It supports various environmental policy objectives, such as the reduction of dispersion of environmental hazardous substances, the re-use of materials (reduction of waste) and the reduction of the application of primary materials (Hustinx et al., 2000).

Of main importance for the current study are: the Pollution of Surface Waters Act (regulating water and sediment quality), the Seawater Pollution Act (regulating disposal of dredged material into the marine environment), and finally the Dutch Building Materials Decree (regulating beneficial use of dredged material).

The main institutional actors for policy and management are situated at the national level. Firstly, because policies and regulations related to sediment/dredged material quality and dredged material disposal are addressed at the national level, and secondly because the national government is involved as manager for the state-controlled waters the river Rhine and the North Sea. This responsibility is in the Rhine Estuary delegated to the RWS - Directorate South Holland and RWS - Directorate North Sea, respectively. Both Directorates are involved in Wvo/Wvz permit granting.

2.2 Immissions (water and sediment quality targets)

Assessment of the environmental quality plays an important role in water policy and management. Environmental quality standards are used to test the current or future environmental quality against policy goals, which, for example, may lead to emission reduction measures. Another example is testing against the sediment standards and classification system, which is relevant for the application of aquatic sediments. Recently, the assessment of environmental quality is focussing at the assessment of the risks posed by contaminants (Beek et al., 1997).

The risk-based approach is a central issue in environmental policy since it's introduction in the first National Environmental Policy Plan NMP (Min. VROM, 1989). The core of the risk-based approach is formed by the risk limits; the Maximum Permissible Risk (MPR/ *Maximaal Toelaatbaar Risiconiveau; MTR*) and the Negligible Risk (NR/ *Verwaarloosbaar Risiconiveau; VR*). The MPR is assumed to aim at a protection level of at least 95% of the species within an ecosystem. The NR is set a factor of 100 below the MPR.

The environmental quality targets (and related classification systems) do not match completely with the above mentioned risk limits, because the quality targets are a result of policy choices, in which historical, economical, technical and societal aspects also play a role. This process in standard setting is known as ALARA (As Low As Reasonable Achievable).

The relationship between the risk limits and the water and sediment quality targets, which are the quality anchor points for both fresh water and marine water systems, is illustrated in figure 2-2.

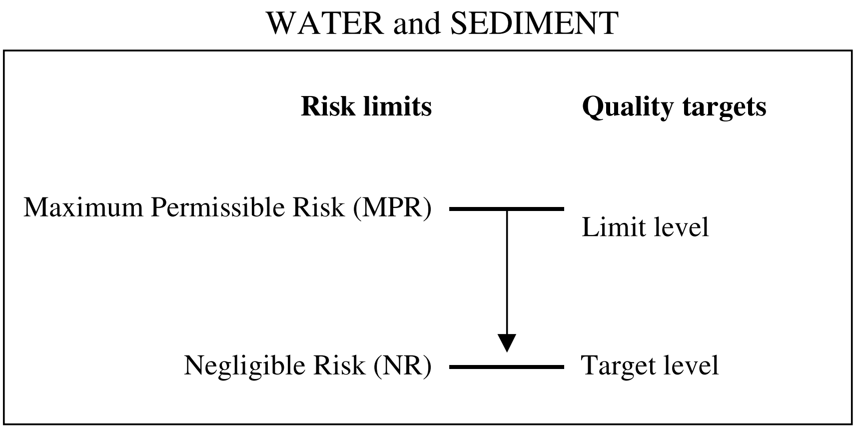


Figure 2-2: Relationship between risk limits and water and sediment quality targets (adopted from Beek et al. 1997).

The quality targets for water are the target level *(streefwaarde)* and the limit level *(grenswaarde)*. The target level, which is the long-term quality objective, is in principle set at the NR. For a limited number of (naturally occurring) substances, such as trace metals, the target level is set at the natural background concentration. The limit level, which is the short-term quality objective, usually does not exceed the MPR, but can also be established between the MPR and NR due the above mentioned 'policy' factors.

The quality targets for sediment are, in principle, analogous to the targets for water, a target level in combination with a limit level. For the evaluation and classification of dredged material, however, three product-based operational levels have been added to define the limit between disposable/non-disposable (see chapter 2.4.3).

The numerical values for the current Dutch surface water and sediment quality targets (for a selected number of compounds) as presented in NW4 (Min. V&W, 1998) are summarised in table 2-1. As mentioned above, the levels are quality anchor points for fresh water and marine water systems. Exceptions are the organotin compounds for which separate values are presented for the marine environment, because effects on marine organisms differ substantially from the effects on fresh water organisms. The MPR values are derived from ecotoxicological data and sediment/water partition coefficients. The handling of the basic ecotoxicological data has been harmonised internationally (ICPR, OSPAR).

For the state-controlled waters, policies affecting water and sediment quality have been elaborated for the period 1995 – 2000 in the Beheersplan voor de Rijkwateren 2 (Min V&W, 1996). In this document 10 themes are defined, which are coupled to so-called target images (*streefbeelden*). The first theme is 'Continuous attention for clean water and sediment' with the following objectives: "*The water (sediment) quality is in agreement with standards in NW3, ENW and the EU directives. Emissions are prevented as much as possible. All activities which affect water quality are legally regulated (Wvo, Wvz, Wbb etc).*"

According to this plan, activities should be directed to the realisation of the prevailing water quality targets and towards a reduction of emissions.

In conclusion, there is a national aim for the improvement of the quality of surface water and sediment and a long-term harmonisation in inland and marine quality targets, which should enable unrestricted marine disposal of estuarine dredged material. However, the 'loose' time frame set and transboundary influences, might hamper the realisation of this objective.

Table 2-1: Dutch quality targets for surface water and sediment (NW4)

Compound	**Unit**	**Surface water (dissolved)**		**Surface water (total)**		**Unit**	**Sediment**	
		Target level	MPR (limit)	Target level	MPR (limit)		Target level	MPR (limit)
Metals								
Arsenic	µg/l	1	25	1.3	32	mg/kg d.s.	29	55
Cadmium	µg/l	0.08	0.4	0.4	2	mg/kg d.s.	0.8	12
Chromium	µg/l	0.3	8.7	2.4	84	mg/kg d.s.	100	380
Copper	µg/l	0.5	1.5	1.1	3.8	mg/kg d.s.	36	73
Lead	µg/l	0.3	11	5.3	220	mg/kg d.s.	85	530
Mercury	µg/l	0.01	0.2	0.07	1.2	mg/kg d.s.	0.3	10
Nickel	µg/l	3.3	5.1	4.1	6.3	mg/kg d.s.	35	44
Zinc	µg/l	2.9	9.4	12	40	mg/kg d.s.	140	620
PAH								
Naphthalene	µg/l	-	1.2	0.01	1.2	mg/kg d.s.	0.001	0.1
Anthracene	µg/l	-	0.07	0.0008	0.08	mg/kg d.s.	0.001	0.1
Phenanthrene	µg/l	-	0.3	0.003	0.3	mg/kg d.s.	0.005	0.5
Fluoranthene	µg/l	-	0.3	0.005	0.5	mg/kg d.s.	0.03	3
Benz(a)anthracene	µg/l	-	0.01	0.0003	0.03	mg/kg d.s.	0.003	0.4
Chrysene	µg/l	-	0.3	0.009	0.9	mg/kg d.s.	0.1	11
Benzo(k)fluoranthene	µg/l	-	0.04	0.002	0.2	mg/kg d.s.	0.02	2
Benzo(a)pyrene	µg/l	-	0.05	0.002	0.2	mg/kg d.s.	0.003	3
Benzo(ghi)perylene	µg/l	-	0.03	0.005	0.5	mg/kg d.s.	0.08	8
Indenopyrene	µg/l	-	0.04	0.004	0.4	mg/kg d.s.	0.06	6
PCB								
PCB-28	µg/l	-	-	-	-	µg /kg d.s.	1	4
PCB-52	µg/l	-	-	-	-	µg /kg d.s.	1	4
PCB-101	µg/l	-	-	-	-	µg /kg d.s.	4	4
PCB-118	µg/l	-	-	-	-	µg /kg d.s.	4	4
PCB-138	µg/l	-	-	-	-	µg /kg d.s.	4	4
PCB-153	µg/l	-	-	-	-	µg /kg d.s.	4	4
PCB-180	µg/l	-	-	-	-	µg /kg d.s.	4	4
Various relevant compounds								
Mineral oil	µg/l	-	-	-	-	mg/kg d.s.	50	1000
TBT	ng/l	0.1 (0.01)	14 (1)	0.1 (0.01)	14 (1)	µg/kg d.s.	0.02 (0.007)	10 (0.7)
Pentachlorobenzene	ng/l	-	300	3	300	µg/kg d.s.	1	100
Hexachlorobenzenze	ng/l	-	9	0.09	9	µg/kg d.s.	0.05	5
Lindane (γ-HCH)	ng/l	-	910	9	920	µg /kg d.s.	0.05	230

Levels are quality anchor points for fresh water and marine water systems (NW4 1998 policy document). Target level is the long-term objective; MPR (Maximum Permissible Risk) is the short-term objective.
Surface water (total) values apply to a suspended matter concentration of 30 mg/l; Sediment values are based on standard soil with 10% organic matter and 25% lutite.
TBT values in parentheses apply to marine waters. A selection of compounds has been included in this table.

2.3 Emissions

2.3.1 Reduction targets

Environmental concern in the eighties has led to decisions to reduce discharges of environmentally dangerous substances drastically. Several action plans were drawn up such as the Rhine Action Plan (RAP; ICPR, 1987) and the North Sea Action Plan (NAP; Min. V&W, 1991) with the aim of quality improvement of rivers, sediment and the Dutch coastal zone. The policy laid down in the ministerial declaration of the Third International Conference on the Protection of the North Sea (ICPNS, The Hague, 1990) concentrates at emission reductions by the application of best available techniques. For dredged material it has been agreed upon to improve the quality of the dredged material to be disposed at sea, by reduction of emissions of pollutants to rivers and estuaries.

The following emission reduction targets have been defined in RAP, ICPNS 1990 and NW3 (for the compounds relevant in the present study):

- 100 % emission reduction in 1995 compared to 1985 for PCB (RAP, ICPNS 1990);
- 70 % emission reduction in 1995 compared to 1985 for cadmium, mercury and lead (RAP, ICPNS 1990);
- 50 % emission reduction in 1995 compared to 1985 for cadmium, mercury, lead (NW3), copper, zinc, PAH, lindane, etc. (Rhine, North Sea)
- 70 – 90 % emission reduction as indicative final targets for the long term (NW3).

At the Fourth International Conference on the Protection of the North Sea (ICPNS, Esbjerg, 1995) the agreement was reached that discharges of all hazardous (noxious, persistent and bio-accumulating) substances should end by the year 2020.

The current (1995) emission levels in the Netherlands are reduced compared to the seventies (table 2-2). Substantial emission reductions have been reached primarily with respect to the point sources from industry and urban wastewater.

Table 2-2: Net emissions in relation to Dutch NW3 reduction targets (Beheersplan voor de Rijkswateren 2, 1996)

Compound	Unit	Emission 1985	Emission 1995	Target 1995	Realisation
Cadmium	tonne	19	1.7	50%	91%
Copper	tonne	210	99	50%	53%
Lead	tonne	320	124	50%	61%
Mercury	tonne	2.4	0.64	50%	73%
Zinc	tonne	780	472	50%	39%
TBT	tonne	10	4.8	50 – 90%	52%
PAHs (sum 6)	tonne	22	18.5	50 – 90%	16%

Emissions to surface water (after waste water treatment), including land-based emissions to the marine environment.

The Dutch 50 % reduction target for heavy metals has been achieved for cadmium, mercury, copper and lead, but zinc emissions have not been reduced sufficiently yet. For the organic micropollutants PCB and PAH targeted reductions were not achieved; a 50 % reduction has been established for TBT (Min. V&W, 1996a).

2.3.2 Emission reduction measures

Even though there has been a clear reduction in point discharges from industrial and communal sources over recent years and a substantial improvement in the quality of water and recently formed sediments, a substantial effort still is required to meet quality targets. The short-term quality targets or MPR values (see chapter 2.3.1) for (amongst others) cadmium, zinc, copper, PAH, PCB and pesticides have not been achieved and the long-term target levels are far beyond reach. For the coastal zone emissions of TBT in anti-foulings and waste of ships form a problem. (Min. V&W, 1996a).

According to NW4 (Min. V&W, 1989), to make further progress in reducing emissions, emphasis should be placed now on tackling diffuse (non-point) sources. In striving to achieve further reduction of emissions from industry, the focus will be put at long-term solutions such as a responsible choice of products and raw materials, clean technologies and the closure of substance cycles. In the shorter term, the emphasis will be on improving corporate environmental management. In 1993 the Dutch Government and the Chemical Industry signed the Chemical Covenant (Intentieverklaring Uitvoering Milieubeleid Chemische Industrie). In the framework of this covenant emission reduction targets for the period until 2010 have been defined in environmental planning reports (Bedrijfs Milieu Plan) of individual companies.

The three current starting points of the Dutch water emission policy, which form the basis for Wvo permit granting (reduction of pollution, the stand-still-principle, and the polluter-pays-principle) will remain important for all sources. In addition to this, greater attention will be paid to life cycle management in reducing emissions from both point and diffuse sources. For the water emission policy this will incorporate prevention, re-use and (wastewater) treatment.

The agreements from the Fourth ICPNS (Esbjerg, 1995) will be elaborated as follows:

- Identification and prioritisation of hazardous substances in EU-, OSPAR- and UN context;
- Inventory of relevant sources, measures and instruments to be employed;
- Evaluation and possibly adjustment of measures taken.

The main categories of diffuse sources include emissions from agriculture, construction materials, shipping, and to a lesser extent traffic and transportation. The measures for agriculture are mainly restricted to N and P emissions and are not treated further, as these substances are not relevant for sediment quality issues in the Port of Rotterdam. Construction material: leaching and oxidation of construction materials (e.g. copper piping and zinc gutters) result in pollution of surface water and soil. The use of sustainable building materials in new developments and renovation projects and possibly the use of environmentally friendly coatings on existing materials will be promoted.

Emissions from shipping include biocides in antifouling paints (TBT), mineral oil and ship waste. In international context (IMO, EU), the Netherlands aim at a reduction and finally a ban on the use of TBT-containing antifoulings in professional shipping by 2010. Waste from shipping contains domestic waste, oil and chemical waste. Abatement of illegal dumping at sea and promotion of user-friendly collection are of importance. For inland shipping the agreements in the framework of the Shipping Waste Treaty (Central Committee Rhine Shipping, 1996) will be implemented in national law. This means the financing of the collection and treatment of waste via a levy on fuel. Coal tar coatings with high PAH content will be replaced by bitumen coatings with a low PAH content. In the future a replacement of these low-PAH coatings is foreseen as well. Since the ban of TBT-containing antifoulings on recreation vessels, copper-containing paints are in use, which unfortunately are hazardous as well. The use of antifoulings in recreational shipping will be reduced further.

Emissions from road traffic reach the surface water mainly indirectly via atmospheric deposition, run-off and stormwater overflows. Generic measures aimed at the reduction of traffic emissions may have an effect, and possibly treatment of run-off water from roads. Emissions from air traffic will be addressed in an international context (Min. V&W, 1989).

For the new planning period till 2006 no new reduction targets will be set for the industry, apart from objectives defined in the Chemical Covenant. Best Available Technologies (BAT) for each sector, as currently elaborated within the EU IPPC guideline, will be the basis for permit granting in the framework of the Pollution of Surface Waters Act (Wvo). It should be prevented that production growth or the introduction of new substances will lead to new problems. The use of clean technologies and preventive measures are encouraged. In addition to the substance-oriented assessment of industrial effluents, the method of Whole Effluent Assessment (WEA) will be implemented for the assessment of sanitation techniques to be used. The substance-oriented approach has the limitation that only a selected number of compounds is considered and that combination effects are neglected. The TEA involves toxicity tests and tests on mutagenicity, bioaccumulation and persistency. In more and more companies environmental management is incorporated via corporate environmental management systems and company environmental plans.

Measures related to urban sewage treatment are mostly aimed at nutrients, but as a side-effect reduction of the emission of heavy metals and organic micropollutants will be achieved as well. The programme of nitrogen removal in sewage treatment plants will be completed. Furthermore, at the regional or local level advanced nutrient reduction or flocculation and sedimentation techniques will be applied. The urban sewage systems will be improved, with a focus on the reduction of storm overflows from sewage systems by the use of retention basins, decoupling of paved urban area's, and infiltration of rainwater. In new construction works improved separate sewage systems will be used (Min. V&W, 1989).

In the 1999 progress report on Dutch water management it is concluded that the focus of the emission management in the Netherlands is evolving towards a focussed target group approach, which also could offer opportunities for the reduction of emissions from diffuse sources (CIW, 1999). In the sectors agriculture and shipping, the Wvo instruments are being implemented for the abatement of diffuse pollution.

To summarise, in Dutch emissions policies and regulations a focus is put at the pollution originating from diffuse sources, amongst others addressing shipping-related emissions. The above mentioned measures will be elaborated in the next management plan for the state-controlled waters (expected in 2001). When the measures will be implemented and after which time period beneficial effects will become evident, is not quite clear. In a 1996 study on the prediction of water/sediment quality for the year 2010 no specific alterations where expected as a result of current (1995) and foreseen measures (Lourens, 1996). An exception was formed by the PAH, for which a quality improvement was expected due to the application of alternative ship coatings.

2.4 Dredged material management

2.4.1 North Sea issues

Management of dredged material from Dutch marine harbours is closely related to North Sea Policies. The Directorate General for Public Works and Water Management Directorate North Sea is responsible for the North Sea management, implementing current and future Dutch North Sea policies and regulations as described in NW4 (Min. V&W, 1998) and the Management plan for the North Sea (Min. V&W at al., 1999).

Water quality in the North Sea and coastal zone has improved markedly over the last decade, but according to NW4 this should be more clearly reflected in a restoration of the ecosystem. The Dutch policies aim at the prevention of the emissions of dangerous substances to the water system. In NW4 and NMP3 the policies with respect to source-reduction and water (sediment) quality have been laid down. For the North Sea the precautionary principle is the starting-point. This means a very restrictive approach with respect to pollution and with respect to disturbance and implies maximum abatement at the source and the striving for negligible risks levels.

The concentrations of many pollutants in the coastal zone and open sea have decreased. Some pollution is still cause for concern, for example TBT. Reduction of organic micropollutants, especially from diffuse sources is still important. One of the main sources for microcontaminants is atmospheric deposition, for which an international air-emission reduction approach is required. As mentioned in chapter 2.3, at the Fourth ICPNS it has been agreed upon that the emission of environmentally dangerous substances will be reduced as much as possible or will be stopped totally. With respect to shipping, operational and illegal discharges of oil shipping waste, domestic waste, and cargo residues remain a problem. Around 90 % of the oil emissions is illegal, which calls for an combined approach by industry and the government. Every Dutch harbour needs to have reception facilities for the collection of waste from shipping. The Netherlands aim at good harbour collection installations in all European harbours.

North Sea environmental policies concentrate at the regulation of emissions and discharges by means of permit/exemption granting, by enforcement of regulations and by making agreements with relevant sectors (Min. V&W, 1998; Min. V&W et al., 1999).

Due to efforts resulting from RAP/NAP and related activities, quality improvements of the river Rhine and the Dutch coastal zone can be observed. Lourens (1996) concluded that the load of pollutants to the North sea has been reduced strongly until the mid eighties. From the nineties the reduction of loads has been moderately and the current loads seem to stabilise. However, for concentrations of contaminants in suspended matter in the rivers still a lowering trend is observed, which questions the usefulness of load calculation as an indicator for emission policy. Annual loads of metals to the sea are dominated by inputs from rivers and dredged material. For PAHs and PCBs atmospheric deposition is also of importance.

The successful reduction of input of contaminants to the marine water is reflected in the concentration of contaminants in the North Sea sediment (Sonneveldt et al., 1999). For copper, cadmium, lead, zinc and PCBs the concentrations in sediment have been reduced in the period

1981–1996 by 40 – 70 %. For PAHs the reduction has been somewhat lower: 25 % between 1986 and 1996.

Recent developments and trends in North Sea hydrology, meteorology, chemistry, biology and human activities, among which disposal of dredged materials and effects thereof are described in the Quality Status Report North Sea 1999 (OSPARCOM, 2000). This report (a follow-up of the 1993 edition), as well as the 'holistic' Quality Status Report for the whole OSPAR region are expected to be available mid 2000.

2.4.2 History of dredged material management

Until the early seventies it was not realised that the quality of dredged materials could form a problem to the environment; it could be disposed without restriction into the North Sea or used on land. From the mid eighties onwards regulations have been applied.

Up until 1989, in the Rotterdam harbour area a geographical classification was used to decide whether estuarine dredged material could be disposed at sea (Salomons, 1985; RMPM, 2000). Based on the pollution gradient from sea to the river, a spatial classification system was developed based on the proportion of sea sediment versus river sediment in the dredged material. In region I, 90 % or more of the dredged material was considered to be of marine origin and therefore should be clean enough to be disposed of at sea. In region II, the sediment was roughly an equal mix of fluvial and marine sediment. As the river was considerably contaminated back in the early 80's, the dredged material from this area had to be stored in a permanent disposal site, the Slufter. Dredged material from region III is of fluvial origin for 90% or more and therefore it also had to be stored in the Slufter. Irrespective of location, a 'class IV' was defined as well: this material consisted of heavily contaminated dredged material, mainly containing high levels of heavy metals and PAHs, which were caused by local sources. This material used to be stored at another disposal site, the Papegaaiebek.

Then in 1989, the policy with respect to the marine waters was described in NW3 as aiming at a further reduction of emissions at the source, including diffuse sources. Further, the policy with respect to dredged material from estuarine harbour areas, especially for the North Sea, was directed at the prevention of the dispersion of the highest contaminated dredged material, by the use of compound-based quality criteria for dredged material in combination with a contaminant load. The water quality objectives for these marine and estuarine areas were the target values (Min. V&W, 1989). A differentiated classification system, based upon chemical concentrations, was introduced for respectively the North Sea, the Delta and Wadden Sea harbours for the assessment of dredged material quality. In principle, material which complied with these values, could be disposed off shore by an exemption of the Seawater Pollution Act (Wvz). In addition to the classification system, a maximum contaminant load was used for the North Sea based on the stand still principle; the total load of contaminants disposed in a specific year at the disposal sites was not allowed to exceed the contaminant load of 1988. The load was defined as the amount of contaminants in excess of the target value.

In 1994, the quality assessment system was revised into a harmonised system for all regions, the so-called Uniform Quality Criteria (UQC) (Min. V&W, 1994). However, for the Rhine estuary (as well as for other area's) for various compounds interim values (*overgangswaarden)* were used. With these interim values it was arranged that for a number of specific compounds the assessment system could be exceeded by a certain established level. According to ENW, in NW4 a decision was to be made with respect to the numerical values of the quality criteria and with respect to the loading criterion. Possibly, the levels for the compounds in the assessment system should be lowered to the level of the limit values. A basis for the above mentioned discussion was to be formed by a study on the effects of regulation of the disposal of dredged material in the North Sea (Lourens, 1996). This study was aimed at an integral approach of the dredged material issue. New aspects in the study were the analysis of the silt balance and the application of life cycle analyses. The final conclusion of the study was that, at the current and expected seawater and dredged material quality, the lowering of the levels in the quality criteria was expected to be only limited effective. Furthermore, it was concluded that such a measure would have negative environmental side-effects (ecological and morphological effects of the withholding of silt as a source of food components) and would be very costly. The contaminant load criterion was judged a less suitable indicator for the success of emission policy.

In the latest Dutch water policy document (NW4), it was confirmed that the level of the Uniform Quality Criteria as established in 1994 will be continued to be used for marine disposal of dredged material and that the contaminant load criterion will be skipped. The interim values for the Rhine estuary expire in 2000. In this document the following policy statement with respect to disposal of dredged material at sea was added:

"*The quality criteria offer, by the limited number of substances which is included, insufficient possibilities to assess the consequences of the complex mixture of contaminants. Therefore, in 2002 an integrated assessment system for dredged material will be available, based upon biological effect measurements and the environmental burden (transition speed c.q. persistency). Before that time the methods will be tested in practice by systematic monitoring during several years*" (Min. V&W, 1998).

Apart from the institutional actors in the field of dredged material management, also various Non-governmental organisations (NGOs) are concerned with this topic, such as Greenpeace and Waterpakt (the latter being a co-operation between Stichting Reinwater, Stichting De Noordzee, Vereniging tot Behoud van het Ijsselmeer and the Waddenvereniging). Their activities vary from the organisation of public actions, the involvement in legal objection procedures, to participation in the policy and scientific debates. In November 1999 a workshop was organised by Waterpakt. In the discussion paper and report of this workshop (Waterpakt, 1999) various aspects of the dredged material issue were discussed.

2.4.3 Current regulations

Disposal in the marine environment

The disposal of dredged material at North Sea disposal sites is regulated via an exemption concerning the Seawater Pollution Act (Wvz). The application is judged amongst others upon the basis of the necessity of the formation of the waste, the possibilities for use/treatment on shore and the consequences of the disposal for the environment. To this end, the degree of contamination of the material is assessed by comparing the chemical concentration levels of contaminants to the Uniform Quality Criteria. When for one or more compounds the level in the UQC is exceeded, the material is not allowed to be disposed offshore and should be put in a depot or be subject to treatment. The permits are issued by the North Sea Directorate for a period of 2 years (Stronkhorst et al., 1999).

The sediment quality in the Rhine Estuary is monitored periodically in sampling surveys organised by the managers, the Rotterdam Municipal Port Management and the Directorate General for Public Works and Water Management - Directorate South Holland, and subsequent chemical analysis of the material. In the even years the sediment in the whole port area is studied, in the odd years only the western part of the area (RMPM/RWS-DZH, 1998).

The Uniform Quality Criteria comprise a list of 35 substances, including metals, PAH, PCB and OCP. Criteria for tributyltin compounds (TBT) have not been incorporated. In table 2-3 an overview is given of the UQC values for the Rhine estuary as applied in 1989, 1994 and 2000, respectively. The testing values for (inland) surface water or land disposal (see below) are added for comparison.

Over the years, the quality criteria for the metals arsenic, copper and lead, for PAH and mineral oil have been lowered (made more severe). Depending on the compound, the levels in the UQC are between the target value and the testing value (see chapter 2.2).

In the OSPAR Guidelines for the Management of Dredged Material (OSPARCOM, 1998) two quality assessment levels are recommended. Level 1 is the level below which no environmental effects are to be expected; in the Netherlands this is fulfilled by the target values. When level 2 is exceeded, extra measures are necessary to limit the environmental burden; in the Netherlands this is fulfilled by the UQC. More and more Member States are implementing the two OSPAR levels. In chapter 5 an overview of OSPAR levels (or sediment quality criteria; 1998 status) for other North Sea riverine states (Belgium, France, Germany, Norway and Sweden) can be found (Lauwaert, 1998). A quantitative comparison of the levels for the various Member States is difficult, because different standardisation procedures for the expression of the chemical values have been used. However, qualitatively it can be concluded that the Dutch criteria list is the most elaborate one with respect to the number of compounds included. An exception is formed by the TBT compounds, which are missing in the Dutch list, but which are included in the Belgian and German criteria (chapter 5).

Inland disposal

It should be noted, that the UQC are product-based operational values to define the limit between disposable and non-disposable estuarine dredged material into the marine environment. A separate quality assessment system exists for the inland disposal of freshwater sediments/dredged material, which is discussed below.

As illustrated in figure 2-3, an ecotoxicological-based quality classification system is defined, in which 5 Classes of *in-situ* dredged material are coupled to a set of 5 sediment quality targets (Min. V&W, 1989; RMPM, 2000).

Table 2-3: Dutch criteria for dredged material disposal in the Rhine estuary

Compound	Unit	Disposal into the marine environment			Inland disposal
		Quality criteria NW3 (1989)	Quality criteria ENW (1994)	**Quality criteria NW4 (1998)**	Testing level NW4 (1998)
Metals					
Arsenic	mg/kg d.s.	37	29	29	55
Cadmium	mg/kg d.s.	4	4	4	7.5
Chromium	mg/kg d.s.	120	120	120	380
Copper	mg/kg d.s.	65	60	60	90
Lead	mg/kg d.s.	120	110	110	530
Mercury	mg/kg d.s.	1.2	1.2	1.2	1.6
Nickel	mg/kg d.s.	45	45	45	45
Zinc	mg/kg d.s.	365	365	365	720
PAHs					
Naphthalene	mg/kg d.s.	2.2	0.8	0.8	-
Anthracene	mg/kg d.s.	0.9	0.8	0.8	-
Phenanthrene	mg/kg d.s.	1.9	1.0	0.8	-
Fluoranthene	mg/kg d.s.	3.4	2.5	2	-
Benz(a)anthracene	mg/kg d.s.	1.5	1.0	0.8	-
Chrysene	mg/kg d.s.	1.9	1.0	0.8	-
Benzo(k)fluoranthene	mg/kg d.s.	10	0.8	0.8	-
Benzo(a)pyrene	mg/kg d.s.	1.9	0.9	0.8	-
Benzo(ghi)perylene	mg/kg d.s.	10	0.8	0.8	-
Indenopyrene	mg/kg d.s.	10	0.8	0.8	-
Sum 10 PAH	mg/kg d.s.	-	-	-	10
PCBs					
PCB 28	mg/kg d.s.	0.03	0.03	0.03	0.03
PCB 52	mg/kg d.s.	0.03	0.03	0.03	0.03
PCB 101	mg/kg d.s.	0.03	0.03	0.03	0.03
PCB 118	mg/kg d.s.	0.03	0.03	0.03	0.03
PCB 138	mg/kg d.s.	0.03	0.03	0.03	0.03
PCB 153	mg/kg d.s.	0.03	0.03	0.03	0.03
PCB 180	mg/kg d.s.	0.03	0.03	0.03	0.03
Sum PCBs	mg/kg d.s.	-	-	-	0.2
Various relevant compounds					
Mineral oil	mg/kg d.s.	2000	1500	1250	3000
TBT	mg/kg d.s.	-	-	-	-
Pentachlorobenzene	mg/kg d.s.	-	-	-	0.3
Hexachlorobenzenze	mg/kg d.s.	0.03	0.03	0.02	0.02
Lindane (γ-HCH)	mg/kg d.s.	0.03	0.03	0.02	0.02

Levels for marine disposal and sediment application (NW4 1998 policy document).
The Quality criteria apply to marine disposal; the testing values for disposal in inland surface water and on land. All values for standard soil with 10% organic matter and 25% lutite.
Starting 1998, for PAH, standard soil correction is no longer applied to sandy soils (organic matter < 10%).
A limited number of organochloro compounds and pesticides has been included in this table.

SEDIMENT QUALITY CLASSIFICATION

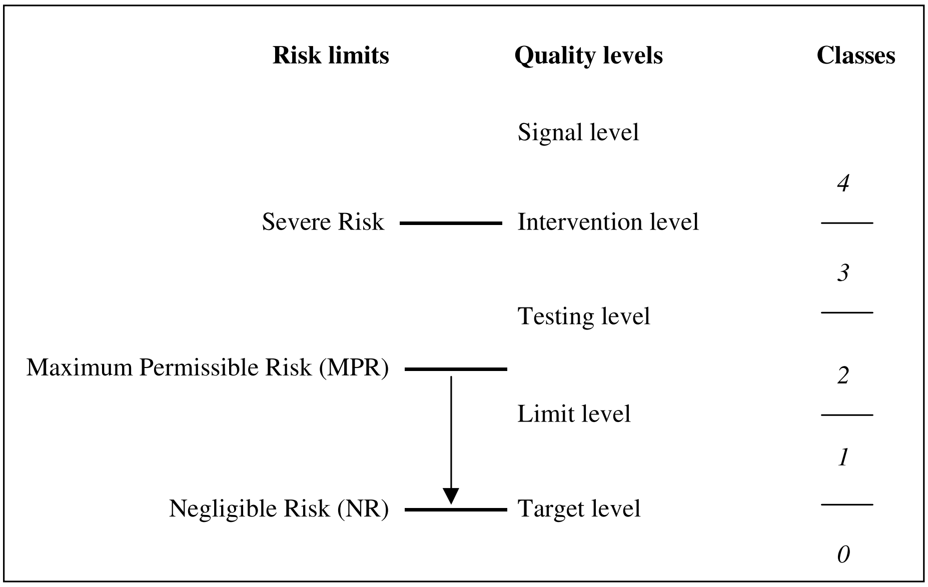


Figure 2-3: Sediment quality classification system (adopted from Beek et al. 1997).

Apart from the target and limit level as discussed in chapter 2.2, this system distinguishes a testing level *(toetsingswaarde)*, an intervention level *(interventionwaarde)* and a signal level *(signaleringswaarde)* for sediment. There are only three risk limits (NR, MPR and the Severe Risk Level) defined. The testing and signal level are not correlated with a risk limit, but are set for practical reasons (Beek et al., 1997).

When the concentrations of all contaminants in the sediment are below the target level, the material poses no threat to the environment. The sediment is considered to be clean and the dredged material is classified as Class 0.

Dredged material with contaminant concentrations between the target and limit level is considered to be lightly contaminated and is classified as Class 1.

Class 2 dredged material is defined as sediment with contaminant levels between the limit and testing level, which is considered to be mildly contaminated. As mentioned above, the testing level is a level set for practical purposes. Freshwater dredged material (from inland waterways) with contaminant levels below the testing level is allowed to be dispersed in freshwater systems or on land under certain conditions, one of them being that the local sediment quality should not deteriorate.

When contaminant levels are between testing and intervention value, the sediment is moderately contaminated and classified as Class 3.

When contaminant levels exceed the intervention level, there is a case of serious contamination; the material is classified Class 4.

The relevant numerical values for these levels are summarised in table 2-1 (target and limit levels) and table 2-2 (testing levels). An overview of the total set (target, limit, testing, intervention and signal levels) can be found in chapter 5.

For the various classes of sediment/dredged material, different disposal options exist. Dredged material in Classes 3 and 4 should be treated or stored under controlled conditions, in order to minimise the influence on the surroundings. For the time being, in contrast to former policy intentions, the dispersal of mildly contaminated (Class 2) dredged material both on land (till 2003) and in inland surface waters (under the constraint of the stand-still principle for the receiving area) is continued, as it is for material classified 1 or 0 (Min. V&W, 1998).

Although the quality of recently formed sediments shows distinct improvement compared to older sediments, problems with widespread contamination still exist. This substantially increases the cost of maintenance dredging. In addition, the restoration of water systems requires not only clean water but also uncontaminated sediments. According to Dutch policies the main solution is to tackle the sources of pollution, but there is also a need to remove severely contaminated sediments (Min. V&W, 1998). In NW4 the policy proposals with respect to sediments are summarised. Over the next few years, consideration will be given to replacement of the rigid classification system for dredged material with a more flexible approach. In this approach, dredged material should either be dispersed without harm to the recipient system, treated (separation, purification, use) where financially feasible, or disposed only as a still indispensable, but environmentally sound and cost-effective, last resort. Direct application of dredged material in the framework of the Dutch Building Decree is encouraged. Furthermore, attention is put at the use of simple treatment techniques, such as sand separation.

2.4.4 Future developments

As mentioned above, it has been recognised in national policy plans that the substance-oriented approach in environmental quality assessment has its limitations. Therefore, in NW4 a development has been started in which effect-integrated measuring and test systems, such as bioassays, will be available and integrated in the assessment framework together with the chemical measuring systems. For the protection of the North Sea, dredging activities and the disposal of dredged material is regulated by policy and regulation*s*. For some aspects the government and the sector would like to see changes (Min. V&W et al., 1999):

- The effects at the various environmental compartments are not fully understood. The uniform quality criteria do not offer, due to the limited number of substances addressed, sufficient possibilities to estimate the consequences of the complex pollution;
- Policy and regulatory framework are considered very strict and not adjusted to execution and enforcement;
- The various responsibilities are unclear.

The government wants to improve the coherence and clarity by the issuing of a new framework (to be introduced in 2002) which covers the whole policy chain as indicated in NW4, from sampling strategies and analyses towards execution of the Wvz exemption system and the enforcement thereof (Min. V&W et al., 1999).

The policy proposal for an integrative assessment system is in line with international developments in for example Belgium, Great Britain and Germany, where bioassays are being implemented in the assessment of dredged material quality. These methods are also advised in the OSPAR Guidelines for the management of dredged materials (OSPARCOM, 1998). In the United States bioassays have been used since the mid 70’s (Stronkhorst et al., 1999).

Sediment bioassays are laboratory toxicity tests in which different species (bacteria, algae, invertebrates, fish) are exposed to extracts of sediments. The objective of the use of bioassays is to assess whether bioavailable contaminants, present in the sample, can cause negative effects at organisms. In this way the possible toxic effects of the mixture of compounds presents can be measured. This in contrast to chemical analyses, in which the concentration levels of a limited number of compounds is measured and evaluated separately. The bioassays presently used, determine acute toxicity (in contrast to chronic toxicity). The results of bioassay tests on harbour sediment give an indication of the possible toxic effects after dispersal of the dredged material at sea. For the assessment of chronic toxicity other end points and a longer exposure time are necessary. As long as such bioassays are not available, chronic effects should be assessed by a substance-oriented approach via incorporation of persistent compounds in the UQC (Lourens. 1996; Stronkhorst et al., 1997). As a drawback of the use of bioassays it is mentioned that causal relationships with pollution sources remain unclear. Additionally, the costs involved in the dredged material monitoring could be raised. Currently, methods are available which trace the sources of observed effects from bioassays according to the concept of Toxicity Identity Evaluation (TIE), possibly in combination with fractionation techniques (chapter E 4.5).

The Directorate General for Public Works and Water Management is responsible for the development of the new assessment system. For this purpose, the project SPECIE*BIO (Stronkhorst 1999; Stronkhorst et al., 1999) has been started under guidance of the Working Group Estuarine Dredged Material *(Werkgroep Zoute Bagger)*, in which the following groups are represented: RIKZ, RIZA, the Regional Directorates, and the Main Office of the Directorate General for Public Works and Water Management. Although almost all organisations involved in estuarine maintenance dredging participate in this working group, RMPM is not a member. The project SPECIE*BIO will develop an integrated chemical-ecotoxicological assessment system for the disposal of estuarine dredged material. The goal of the new assessment framework is the optimisation of the use of depots for the most toxic estuarine dredged materials (e.g. the Slufter). Starting points are: the maximisation of the disposal of dredged material off shore, and on the other hand the minimisation of the environmental burden to the marine environment (toxicity and input of persistent substances). In 2002 this new assessment framework will be incorporated as a practical guidance in the Manual Contaminated Sediments *(Handboek Verontreinigde Waterbodems)*, to be issued by AKWA *(Advies- en Kenniscentrum Waterbodems)*.

The project aims in the first place at the development and validation of testing protocols for bioassays, secondly at the development of assessment criteria, and furthermore at the systematic monitoring of sediment toxicity in Dutch harbours. Policy implementation, provision of information and international harmonisation will be addressed as well. In the various stages of development of the system national and international fora, such as IMO (London Convention), OSPAR (SEBA working group) and PIANC, will be consulted.

The following activities have been executed or planned in the project:

- 1998: Preparation of standard operating procedures and a quality assurance system for bioassays for estuarine dredged material; first interlaboratory study.
- 1999-2000: Consultation policy aspects and systematic monitoring (chemical and bioassays) estuarine dredged material.

- 2001: Choices with respect to the parameters and the levels of assessment criteria; (inter)national harmonisation. Establishment of consequences for dredged material management (amounts disposed in sea, amounts in depot).
- 2002: Implementation in Wvo and Wvz permit and exemption framework.

During the development of this integrated biological-chemical assessment system various technical/methodological aspects have to be covered. In 1998, protocols have been made for 7 bioassays (as well as for sampling of harbour sediment for toxicity tests). For these bioassays validation research and research into interfering factors during execution have been performed, together with an interlaboratory study. The finalisation of the protocols will be performed on the basis of the outcome of the research results. Furthermore, international standardisation of the SOPs will be performed in co-operation with the US-EPA.

The combination of bioassays to be used (a so-called test battery) is, apart from requirements with respect to reproducibility, feasibility, costs and discriminative power, selected on the basis of the following criteria:

- selection of species from different taxonomic and trophic levels;
- selection of species with varying ecological roles, or species which acquire their food in different ways (filter feeder, deposit feeder);
- selections of species which are exposed to contamination in various ways, for example via pore water, via their food, or by uptake of soil particles.

The set of currently proposed and tested bioassays (Corophium volutator *slijkgarnaal;* Echinocardium cordatum *zeeklit*; Microtox SP, CALUX) is in agreement with the above mentioned criteria. The degree of toxicity observed in the bioassay tests, result in a classification according to: non-toxic, moderately *(matig)* toxic, and severe *(ernstig)* toxic. For the assessment of moderately contaminated dredged material, particularly the distinction between non-toxic and moderately toxic is of importance (Lourens, 1996; Stronkhorst et al., 1997).

A first survey into the actual sediment toxicity in Dutch harbours has been executed in 1994-95. A quarter of the annual disposable dredged material supply has been tested with 4 bioassays. In approximately 20% of the samples acute toxic effects were observed. Combination toxicity and unidentified contaminants might be the cause of this (Stronkhorst et al., 1997). In 1999, a systematic monitoring with bioassays was started, coupled to the routine sampling in the framework of the Pollution of Surface Water Act and Seawater Pollution Act. In total about 140 samples from the Wadden Sea, the Delta and the North Sea coastal zone were examined. This will be repeated in 2000. The results of the monitoring have not been made public yet.

In addition to the ecotoxicological research, an evaluation of the chemical parameters of the UQC is performed. This survey is aimed at the identification of compounds which do not (often) exceed the quality criteria and therefore can be removed and at the identification of 'new' compounds which should be added to the quality criteria. Further, the influence of standardisation to standard soil is addressed. The results of the chemical evaluation are expected to be available in 2000 (Yland et al., 1999).

The final lay-out of the integrated assessment system is not established yet. Various scenarios for multi-criteria evaluation of results from chemical analysis and bioassay testing are currently discussed by Rijkswaterstaat and parties concerned with dredged material management, with a general aim at a cost-effective system with optimal environmental benefits (see for example the report of the Policy workshop). During the policy implementation of the new assessment framework, the relation with emission policy and the harmonisation with assessment methods which are currently being developed for fresh water sediment and effluents (Total Effluent Assessment) will be discussed (Stronkhorst, 1999; Stronkhorst et al., 1999).

2.4.5 Link with international regulations

The international policies and regulatory framework with respect to immissions, emissions and dredged material management are discussed in chapter 4.

As a EU Member State, the Netherlands are under the influence of the EU policy and regulatory framework (see chapter 4.1). One of the main EU issues in the context of the present project is the forthcoming European Water Framework Directive (EU-WFD). According to the Dutch project group for the implementation of the EU-WFD (Min. V&W, 2000), the Dutch emissions policy with emphasis on the precautionary principle, life-cycle management and the system of risk assessment fits in well with the Directive, and so is the combined approach of discharges via point sources and diffuse sources. In some aspects, however, the Directive seems to be less stringent than Dutch policy. During the 1995 North Sea Ministers Conference in Esbjerg, the Netherlands have committed themselves to the total ban of all dangerous substances from water within 25 years. The European Directive is more moderate in its aim of 'progressive reduction of emissions of dangerous substances'. Also the European quality targets may in some cases differ substantially for the Dutch ones. The Dutch targets can be much more severe than the ones in the Directive, by for example specific weather conditions or specific conditions of the sediment. The project group concludes that such differences should be settled in the final river basin management plans, in order to prevent legal inequality with respect to permit and product policy. Furthermore, it should be established, whether as a result of the EU-WFD, the coastal zone border is shifting that far into the sea that is has consequences for existing agreements on marine dredged material. By the implementation of a more sea-bound coastal zone, this activity could fall under the jurisdiction of the European Directive, in stead of the OSPAR Convention (Min. V&W, 2000).

The Netherlands are a contracting party to the International Conventions for the protection of the marine environment, the London Convention (LC) and the Oslo and Paris Convention (OSPARCON) for the protection of the North-East Atlantic Sea and are represented in the working groups addressing dredged material disposal. In the framework of these conventions, guidelines have been adopted concerning dredged material management in the marine area (see chapter 4.2). As a contracting party, the Netherlands are obliged to take these guidelines in consideration for regulation procedures for dredged material (OSPARCOM, 1998).

Finally, the Netherlands are a member of the International Commission for the Protection of the River Rhine (ICPR), in which framework improvement of Rhine sediment quality and the protection of the North Sea are two main objectives (see chapter 4.3).

References

Beek, M.A., Knoben, R.A.E. (1997): Ecotoxicologische risico's van stoffen voor watersystemen (RIZA 97.064).

Commissie Integraal Waterbeheer (CIW) (1999): Water in beeld -Voortgangsrapportage waterbeheer 1999.

DZH/RMPM (1999): De kwaliteit van de waterbodem in het Rotterdamse havengebied 1981 – 1998.

Gemeente Rotterdam (1999): Ruimtelijk Plan Rotterdam 2010. Voortontwerp structuurplan.

Gemeente Rotterdam et al. (2000): Waterplan Rotterdam 2000 (in prep.).

Huisman, P., Cramer, W. van Ee, G., Hooghart, J.C., Salz, H., Zuidema F.C. (1998): Water in the Netherlands – Netherlands Hydrological Society (NHV) special 3.

ICPR (1987): Aktionsprogramm 'Rhein'. 8. Rheinministerkonferenz, Straatsburg, 1October 1987.

Lauwaert, B. (1998): Sediment Quality Criteria (SQC) – Overview of the North Sea riverine states. OSPA-SEBA working group.

Lourens, J.M. (1996): Speciemanagement. Effect van het reguleren van het storten van zoute baggerspecie in zee (RIKZ-96.017).

Min. V&W (1989): Derde Nota Waterhuishouding, Regeringsbeslissing (NW3; TK 1988-1989).

Min. V&W (1991): Noordzeeactieplan. Nationaal Uitvoeringsdocument Derde Noordzeeministersconferentie.

Min. V&W (1994): Evaluatienota Water (ENW; TK 1993-94).

Min. V&W (1996): Achtergrondnota Toekomst voor water (WSV 1996).

Min. V&W (1996a): Beheersplan voor de Rijkswateren 2 (periode 1997 t/m 2000).

Min. V&W (1998): Vierde Nota Waterhuishouding, Regeringsbeslissing (NW4; TK 1999).

Min. V&W/LNV/VROM/EZ (1999): Beheersvisie Noordzee 2010.

Min.V&W (2000): Europese kaderrichtlijn water, een tussenstand.

Min. VROM (1989): Nationaal milieubeleidsplan (NMP).

OSPARCOM (1998): OSPAR Guidelines for the Management of Dredged Material

OSPARCOM (2000): Quality Status Report North Sea 1999; Holistic Quality Status Report 1999.

Prov. Zuid-Holland (1999): Concept Ontwerp Beleidsplan Milieu en Water 2000-2004 – Strategisch deel en Toetsingsdeel.

RMPM (1999): Annual report 1998 Rotterdam Municipal Port Management RMPM (2000): Personal communication.

RMPM (2000): Classification systems for sediment quality and dredged material handling, disposal and beneficial use in the Netherlands.

RMPM, RWS-DZH (1998): Brochure De Slufter – Berging en verwerking van verontreinigde baggerspecie.

Salomons, W. &. Kerdijk, H (1985): Geochemisch gedrag van microverontreinigingen. In: V.W.J. van Bergen et al., eds. Proceedings Symposium Onderwaterbodems, rol en lot. Rotterdam.

Sonneveldt, R. & Laane, R. (1999): Waterbodem kustzone wordt schoner, AKWA Newsletter nr. 5, May 1999.

Schipper, C.A. & Stronkhorst, J. (1999): Handboek Toxiciteitstesten voor Zoute Baggerspecie.

Stronkhorst, J. (1999): Productplan SPECIE*BIO – Ontwikkeling van een Nieuw Beoordelingssysteem voor de verspreiding van baggerspecie in Zoute Wateren. Werkdocument RIKZ AB-99.105.

Stronkhorst, J., Maas, J.L., van de Guchte, C., Hartnack, J., Lourens, J.M., Vonck, A.P.M.A. (RIKZ/RIZA) (1997): Baggerspecie, meer of minder schadelijk – kwaliteitsbeoordeling met bioassays (FWVO nota 97.04).

Stronkhorst J., & De Jong, S. (1999): Beleidskader, Onderzoek en Procedures voor de Verspreiding van Baggerspecie in Nederlandse Zoute Wateren. RIKZ/AB-99.120x (in prep.)

Waterpakt (1999): Is zoute bagger lekker? Discussiestuk en verslag van de workshop over biologische beoordeling van zoute bagger op 3 november 1999. Uitgave Stichting Waterpakt, Harlingen.

Yland, E.M.L., Sonneveldt, H.L.A., Stronkhorst, J. (2000): Evaluatie chemische toetsing zoute baggerspecie. RIKZ-2000-005 (in prep.)

3 The National policy framework in Germany

The German environmental policy framework consists of laws and policy statements. Due to the Federal structure of Germany, both the laws and policy statements are made by the Federal Parliament and the states *(Länder).* Depending on the item, the competence of the Federal Parliament and *Länder* varies. Four types of legislation with differing competencies of the Federal Parliament and *Länder* can be distinguished:

a) *ausschließliche Bundesgesetzgebung*, i.e. the Federal Parliament and its upper house have the sole legislation competence;

b) *konkurrierende Gesetzgebung* (concurrent legislation), i.e. the *Länder* have the legislative competence so long as the Federal Parliament has not legislated in the respective area.

c) *Rahmengesetzgebung des Bundes* (Federal framework legislation), i.e. the Federal Parliament adopts a law providing principles and guidelines for specific elaboration by the *Länder* Parliaments.

d) *ausschließliche Landesgesetzgebung*, i.e. the *Länder* have the sole legislation competence

The decision, to which type of legislation each subject belongs to, is stated in the constitution of the Federal Republic of Germany.

With respect to the pollution pathway, pollution can be controlled by establishing standards at the source (emission approach, emission principle) and/or by setting standards at the environmental effect level (immission approach, immission principle).

The German environmental policy framework is mainly based on the emission principle, which is supported by the immission principle.

Further the German environmental law is based on a compartment approach (concerning the environmental compartments water, soil and air), for example embodied in the Water Management Act (*Wasserhaushaltsgesetz* - WHG), and on a sectorial approach (source related approach), for example in the Plant Protection Act (*Pflanzenschutzgesetz* - PflSchG).

Figure 3-1 gives an overview of the German immission and emission approaches and its main regulations, which are relevant for sediment quality. The Federal and *Länder* legislation competencies are marked in colour.

There is a hierarchy of laws, starting from the act, its ordinances, rules (*Satzungen*) and down to administrative provisions (*Verwaltungsvorschriften*). The form of law is important for its commitment to citizens, administration and court. Whereas the first three forms are binding for all of them, the administrative provisions, like e.g. the Technical Directive on Air (*TA-Luft*), is only binding for administration. Many environmental standards are stated in administrative provisions.

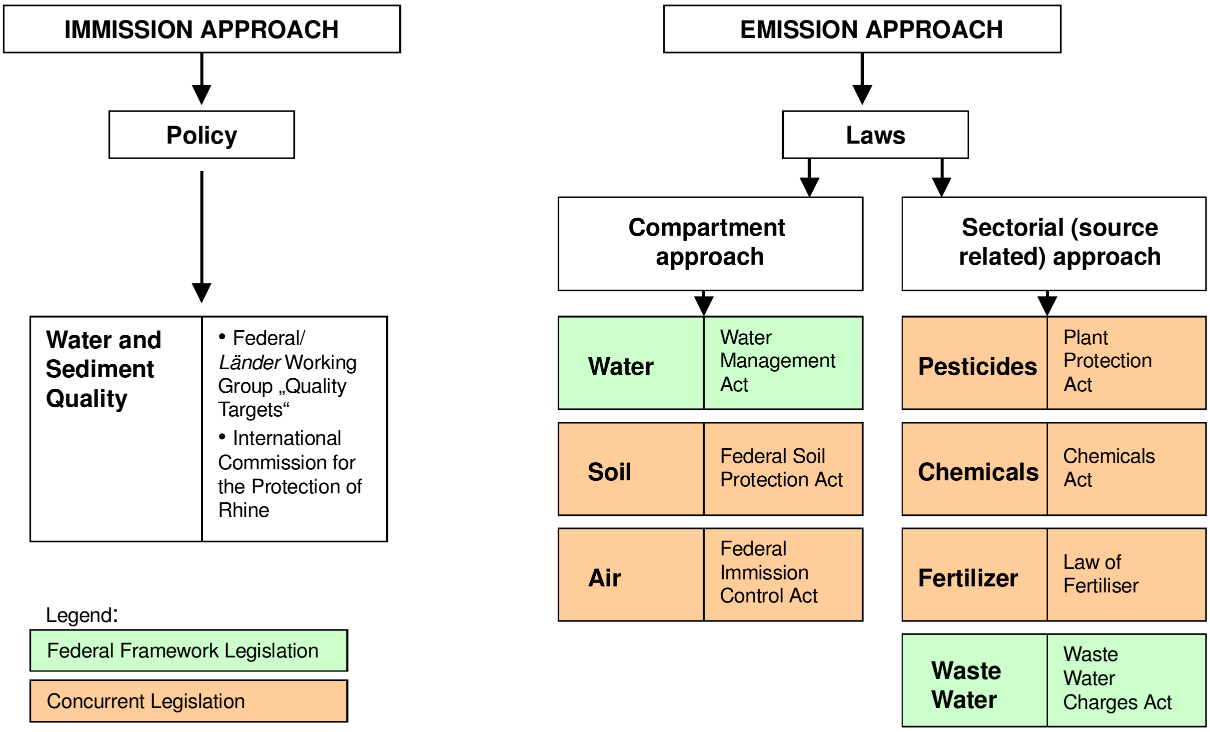


Figure 3-1: German immission and emission approach, its main regulations concerning sediment quality and its competencies of Federal and 'Länder' Parliament

3.1 Water and sediment quality targets (immission approach)

With respect to the pollution pathway, pollution can be controlled by establishing standards at the source (emission control, emission principle) and/or by setting standards at the environmental effect level (immission approach, immission principle). The aim of this chapter is to give a brief overview over the German immission approach concerning water and sediment quality targets for rivers and the marine environment.

The main tool of the German water policy, based on the German Water Management Act (*Wasserhaushaltsgesetz* – WHG), is the emission principle. It is supported by the immission principle, which serves as second tool for ensuring that the water quality achieved due to the emission principle is sufficient (BMU, 1998).

First of all, relevant terms for dealing with the immission principle in Germany have to be clarified. According to the Federal/*Länder* Working Group on quality targets (*Bund/Länder Arbeitskreis Qualitätsziele* - BLAK QZ) the term 'water quality targets' (*Zielvorgaben für Gewässer*) are scientifically based guide values, which are not legally binding (1993). But 'water quality objectives' (*Qualitätsziele für Gewässer*) and 'water quality standards' (BLAK QZ, 1997), 'water quality criteria' or 'immission standards' in a more general meaning are legally binding.

For the marine environment neither water quality targets nor water quality objectives exist in Germany (BLAK QZ, 1997; UBA, 1999). This is caused by the difficulty of establishing credible quality objectives for the marine environment because of its ecological complexity (Gregor, 1994). Moreover, ecotoxicological methods for assessing the impact of pollution on the marine environment are still under development (Claussen & Irmer, 1996).

For inland surface waters, a national biological and chemical quality classification system exists. The biological classification system is divided into seven classes. The classification is based on indicator organisms (saprobe-system). It classifies the degree of organic pollution which will be degraded under oxygen consumption. The biological water quality target represents a moderate load of pollution (*mäßig belasted*), which is the third class (Class II, after Class I and I-II).

The chemical classification system for inland surface water is based on water quality targets developed by BLAK QZ (1997 & 1998). BLAK QZ has established water quality targets for hazardous substances pursuant to § 7a WHG. Hazardous substances are defined as substances or groups of substances which have to be judged as hazardous because of concern about their toxicity, persistence, potential accumulation or their carcinogenic, teratogenic and mutagenic effects (§ 7a WHG).

The substances of concern include 7 heavy metals, a number of pesticides and 28 other organic substances (BLAK QZ, 1997, 1998a & 1998b). The water quality target depends on the object of protection (*Schutzgut*). The following objects of protection have been considered (in alphabetical order) (BLAK QZ, 1997 & 1998a):

- *aquatic community*
- *drinking water supply*
- *fishery*
- irrigation of agricultural used land
- marine environment with respect to the impact of pollution caused by river run off
- recreation
- *suspended matter and sediments*

The italic written objects are of special importance for the derivation of water quality targets. The objects of protection are further defined in the BLAK QZ reports (1997 & 1998). The water quality targets are based on ecotoxicological data. Several national environmental acts and international regulations have been considered, e.g. the Water Management Act (*Wasserhaushaltsgesetz* - WHG), the Drinking Water Ordinance (*Trinkwasserverordnung* - TrinkwV) (which belongs to the Foodstuffs Act (*Lebensmittel- und Bedarfsgegenständegesetz*- LMBG), the Plant Protection Act (*Pflanzenschutzgesetz* - PflSchG) and international conventions for the protection of the marine environment.

However, for the purpose of the project, the object of protection 'suspended matter and sediments' is of primary interest. Following the definition of BLAK QZ, the protection includes *inter alia* the benthos and the usage of dredged material for: soil improvement, agricultural and landscape purposes.

Due to the common lack of ecotoxicological data for sediment organisms, sediment quality targets are derived from ecotoxicological data for the aquatic phase, translating them to sediments by the application of sediment/water partition coefficients for the contaminants concerned.

The water quality targets for heavy metals are listed in table 3-1. For comparison, water quality targets of BLAK QZ and of the International Commission of the Protection of the Rhine (ICPR) are also listed. Further information about the ICPR is given in chapter 4.3.

Table 3-1: Comparison of the water quality targets for 7 heavy metals stated by BLAK QZ and ICPR in mg/kg (suspended matter) or µg/l (water phase) (BMU, 1998)

Substance	Water quality target BLAK-QZ					Water quality target (suspended matter) ICPR
	(A) mg/kg	(S) mg/kg	(D) µg/l	(F) µg/l	(I) µg/l	mg/kg
Lead	100	100	50	5	50	100
Cadmium	1,2	1,5	1	1	5	1
Chromium	320	100	50	-	50	100
Copper	80	60	20	-	50	50
Nickel	120	50	50	-	50	50
Mercury	0,8	1	0,5	0,1	1	0,5
Zinc	400	200	3000	-	1000	200

object of protection:
A = aquatic community
S = suspended matter and sediments
D = drinking water supply
F = fishery
I = irrigation of agricultural used land

BLAK QZ has also developed water quality targets for a number of pesticides and 28 other organic substances. Neither polycyclic aromatic hydrocarbons (PAHs) nor polychlorinated biphenyls (PCBs) are considered, but hexachlorbenzene. Moreover, the ICPR has established water quality targets for pesticides and for organic substances (see appendix 4.3 a), including PCBs (PCB 28, 52, 101, 118, 138, 153, 180 for each 0.0001 µg/l concerning the object of protection 'aquatic community') and PAHs (benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene 0.1 µg/l for the object of protection 'drinking water supply').

The first evaluation of the water quality targets of BLAK QZ for organic substances (for the years 1990-1993) has shown that for the 'aquatic community' the targets are met by 20 substances, 7 substances exceed the targets.

The results of the first evaluation of the water quality targets for heavy metal (for the year 1996) showed that the 'aquatic community' and 'suspended matter and sediments' are endangered, because the concentrations exceeded the quality targets. This is mainly due to cadmium (for the 'aquatic community'), copper, nickel and zinc (for 'suspended matter and sediments'). For further details see BLAK QZ (1997 & 1998).

To summarise, the water quality targets of BLAK QZ or UBA are similar to those of ICPR. Some differences concerning the water quality targets for the organic compounds are partly due to the fact that ICPR also considered the 'terrestrial community' as an object of protection (BMU, 1998).

At the 45th German Conference of the Ministers for the Environment in 1995, it was declared that the concept of water quality targets for organic compounds proved to be worthwhile and its application was recommended in the execution in water management (BMU, 1998).

3.2 Regulations concerning emission control

As mentioned before, the German environmental law is based on two approaches, a compartment approach (concerning the environmental compartments water, soil and air), for example embodied in the Water Management Act (*Wasserhaushaltsgesetz* - WHG), and a sectorial approach (source related approach), an example being the Plant Protection Act (*Pflanzenschutzgesetz* - PflSchG). In the following the environmental acts which are of main interest for the reduction of emissions are examined.

3.2.1 The Federal Immission Control Act (BImSchG)

The Federal Immission Control Act (*Bundes-Immissionsschutzgesetz* - BImSchG) from 1974 is the German regulation of emission control to the atmosphere and therefore discussed in this chapter. The act, subject to concurrent legislative powers (*konkurrierende Gesetzgebung*), aims to protect humans, animals and plants as well as water, soil, atmosphere and cultural assets against negative environmental impacts (Beck, 1988). It deals with environmentally harmful effects of air pollution, noise and substantial disturbance by industrial plants, the last, if they are subject to permission.

The act was last amended on 23.11.1995. It forms the basis of nation-wide, comprehensive law on air quality, noise abatement and industrial plant safety. The act contains, among other things, regulations for the construction and operating of environmentally hazardous facilities, requirements for substances, the composition and operating of motor vehicles and the construction of traffic systems. The consideration of the precaution principle was an important progress in German immission control (Engelhardt & Schlicht, 1997).

The Federal Immission Control Act is mainly influenced by the Single European Act (*Einheitliche Europäische Akte*) in which the main principles and purposes of the acting of the member states are defined and parts of it are concerned with the scope of environment (see chapter 4.1). Besides several European directives influence the German regulation, such as for example:

- Directive 96/61/EC of avoidance and reduction of environmental pollution 1996;
- Directive 85/337/EEC of the Environmental Impact Assessment (EIV), finally amended 1996;
- Directive 84/360/EEC of reducing air pollution by industrial plants 1984, finally amended 1994;
- Directive 80/779/EEC of threshold values for dust 1980 (dust has an indirect influence on the pollution of sediments via particle bound contaminants) (Engelhardt & Schlicht, 1997).

The following statements are restricted to parts of the Immission Control Act that pertain to emissions and immissions of industrial plants and traffic.

Part 2 of the Immission Control Act: Harmful environmental impacts and substantial disturbance of the public by industrial plants have to be avoided by using the 'Best Available Technique' (BAT). BAT is defined as an up-to-date technique, procedure, operating equipment or method that guarantees an emission reduction and that in practice is already tested successfully (Jarass, 1999). In consequence, harmful air pollution that cannot be technically avoided, is allowed. Emission thresholds and air quality values (Directive 84/360/EEC) must be complied with (see appendix 3.2.1 d). If the demands of immission control are not fulfilled the plant looses its operation authorisation.

Part 3 of the Immission Control Act: The German government is allowed to pass regulations about threshold values against air pollution. This part of the act deals with the composition of industrial plants, substances, products, fuels and lubricants. In general one of the aims is to prevent increasing air pollution due to the growing consumption of fuels and lubricants that is one of the diffuse sources of the pollution of sediments. The provision of the composition and quality of fuel is defined in the 10th Ordinance of the Immission Control Act (Jarass, 1999). But in practice, the quality thresholds for fuels are defined with regard to automobile techniques and do not deal with air pollution. Reducing air pollution due to traffic is regulated by the European thresholds of exhaust gases that have to be fulfilled automatically by every EU-member state without a national implementation (Ministry of Environment (BMU), 2000).

Obligations from bilateral conventions or legally binding European Directives have to be taken into account, as for example:

- the EU-Directive 93/12/EC about the content of sulphur in fuel (Council of the EC, 1993);
- the EU-Directive 76/769/EEC about hazardous substances and preparation (PCB, PCT, VC), finally amended in 1994 (Council of the EC, 1994);
- the EU-Directive about lead in gasoline, finally amended in 1987 (Council of the EC, 1987).

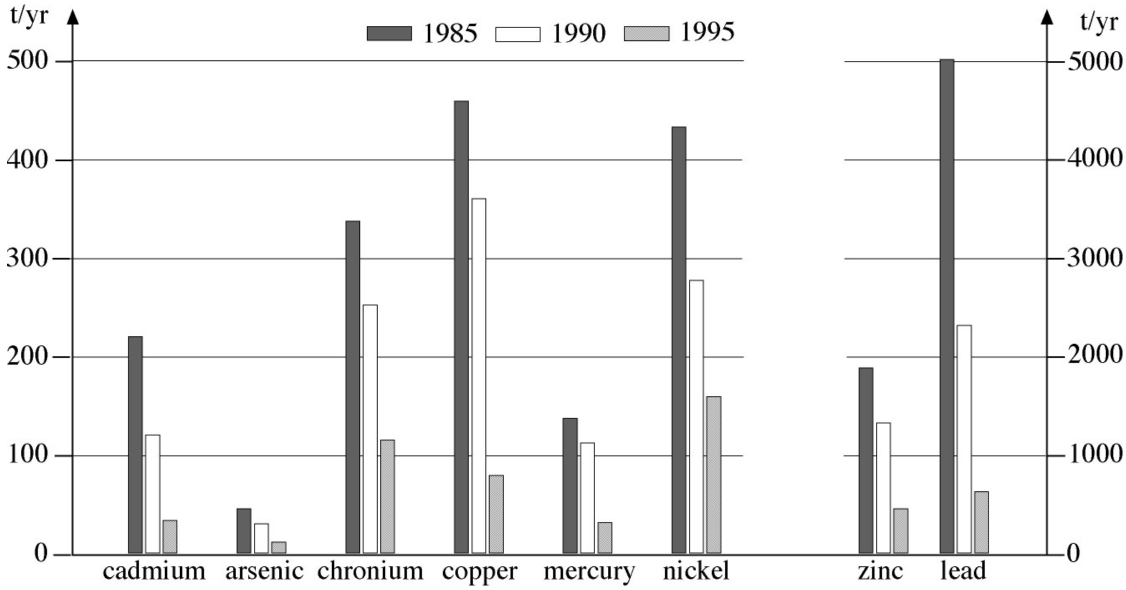
Part 5 of the Immission Control Act: An air pollution monitoring system has to be installed in areas where environmental impacts are expected. Emission registers should be developed. If the immission threshold value is exceeded a sanitation plan has to be compiled (Engelhardt & Schlicht, 1997).

The regulations for the implementation of the Federal Immission Control Act are specified in appendices 3.2.1 a-c. More details about European Directives concerning air pollution can be found in appendix 3.2.1 d.

In the last 20 years the amendments of the Immission Control Act since 1974 led to more stringent emission thresholds. With regard to heavy metals the most important reductions were achieved for lead, cadmium, copper, nickel and chromium (see figure 3-2). After the ban of the PCB production in Germany the emissions of PCBs decreased (see chapter 3.2.6).

The administrative provisions of the Immission Control Act (*Technische Anleitung Luft*) will be amended in the year 2001, because many of the provisions are outdated, i.e. they are more than 10 years old. It is expected that the thresholds of all air pollutants will be more stringent than today, although they are already lower than in most of the other EU member states (Kramer 2000). This development may result in lower air pollution and hence in less contaminated sediments and dredged material.

Figure 3-2: Heavy metal emissions in Germany 1985-1995 (Federal Environmental Agency (UBA), 1997)



The administrative provisions of the Immission Control Act (*Technische Anleitung Luft*) will be amended in the year 2001, because many of the provisions are outdated, i.e. they are more than 10 years old. It is expected that the thresholds of all air pollutants will be more stringent than today, although they are already lower than in most of the other EU member states (Kramer 2000). This development may result in lower air pollution and hence in less contaminated sediments and dredged material.

3.2.2 The Federal Soil Protection Act (BBodSchG)

The Federal Soil Protection Act (*Bundes-Bodenschutzgesetz* - BBodSchG) entered into force on the 1.3.1999 and is subject to concurrent legislative powers (*konkurrierende Gesetzgebung*) (Beck, 1988). Since then not only water and air but also soil has been protected by national law and treated as a scarce resource, endangered by increasing environmental pollution (Holzwarth et al., 2000). Already in 1994 the Enquete-Commission of the 13th Federal Parliament 'Environmental and Human Protection' defined soil as a non-renewable resource, which should not be damaged by toxic immissions. Emissions of persistent, bioaccumulative and toxic substances from industrial plants, agriculture, private households, traffic and other sources, which have irreversible impacts on the soil, should be avoided (Enquete-Commission, 1994). In 1999 the Federal Government adopted this point of view and by passing the Soil Protection Act it defined the target to avoid harmful impacts on the soil and to sustain its natural functions as well as its function as archive of the history of nature and culture (Holzwarth et al., 2000).

The German soil protection law integrates precautionary soil protection and sanitation of contaminated sites. It consists of five parts:

1. The objective of this law is to ensure or to recuperate soil functions. Therefore damaging changes to the soil have to be prevented. Soil, contaminated sites and polluted water must be sanitised and precautionary measures to avoid harmful impacts on soil should be installed.

This law has no validity if other regulations control the emission impacts on soil, such as, the circular flow economy and waste law (*Kreislaufwirtschafts- und Abfallgesetz*), regulations concerning the use of fertilisers and pesticides, the federal immission protection law and the German forest law (Holzwarth et al., 2000).

2. Measures for the protection of soil and sanitation (cleanup) of contaminated sites, estimation of potential dangers, unsealing of sites, criteria for disposal of material in or on soils and threshold values.

   Measures have to be implemented to prevent the accumulation of hazardous substances above precautionary values. However, exceeding of these values is allowed if the total loads of pollutants per year is lower than the threshold value for yearly total loads (see appendix 3.2.2 a). The precautionary values are based on ecotoxicological impacts. If no limits are defined the immissions of substances should be as low as technical and economically possible (Queitsch, 1999).

   For soils which are already contaminated and/or whose soil functions are damaged, measures are implemented only for the reduction of danger and for sanitation. Pollution limits, i.e. test values, vary due to different uses of soils. If the test values are exceeded, the authorities are obliged to take measures (Queitsch, 1999).

   The sanitation of waters is regulated by the water supply law, because concerning water supplies the Federal Government is allowed only to define a framework (Holzwarth et al., 2000).

3. Supplementary regulations for contaminated sites;
4. Avoidance of wind and water erosion by agriculture;
5. Final regulations about for example demands on analytic institutions, the hearing of concerned interest groups and the completion of European resolutions (Holzwarth et al., 2000).

A European soil protection framework still does not exist. In 1998 Germany was the initiator of a 'European Soil Forum' to improve soil protection in Europe. The European Community, the European member states, the potential member states and Switzerland take part in this working group (Holzwarth et al., 2000).

The Federal soil protection law is elaborated in regulations from 16.7.1999:

Annex 1: Requirements of sample taking, analysis and quality assurance;

Annex 2: Definition of test and precaution values and permitted total loads of pollutants per year (see appendix 3.2.2 a);

Annex 3: Requirements of sanitation;

Annex 4: Examination and evaluation of damage due to soil erosion (Queitsch, 1999).

Soil protection is quite important not only for terrestrial ecosystems but also for fluvial and marine systems. As could be shown in chapter 4.2 an substantial part of pollutants are transported into the River Rhine by soil erosion. Therefore the quality of dredged material in Rotterdam depends not only on the pollution level of the soil in the Rhine catchment area but also on measures to protect soil erosion as well as soil contamination. Moreover soil contaminants could be leached by soil water and transported via groundwater into the rivers.

3.2.3 Water Management Act (WHG) and Waste Water Charges Act (AbwAG)

The German federal law concerning the regulation of water management is the Water Management Act (*Wasserhaushaltsgesetz* - WHG).

The Federal Water Management Act is a framework act (*Rahmengesetz*), i.e. the Federal Parliament adopts a law providing principles and guidelines for specific elaboration by the *Länder*.

The Water Management Act shall be applied to surface waters, ground water and national coastal waters (§ 1 WHG). Drinking water supply is subject of the Foodstuffs Act (*Lebensmittel- und Bedarfsgegenständegesetz* - LMBG), with its Drinking Water Ordinance (*Trinkwasser-verordnung* - TrinkwV).

The basic principle of the Water Management Act is the following: Waters have to be protected as an integral part of the nature and as a biotope for animals and plants. They shall be managed in such a manner as to serve the public interest, and in harmony with this principle they also benefit the individual users. Management must prevent any avoidable harmful impact to its ecological function (§ 1a I WHG). In addition to that a duty of a careful water management by everybody is stated in § 1a II WHG.

The Water Management Act, partly supported by the Waste Water Charges Act (*Abwasserabgabengesetz* – AbwAG) states the following measures to meet the objectives:

1. Any use of water requires a permit or concession (§§ 2, 6, 7, 8 WHG). Uses of water includes amongst others disposal and discharge of substances in coastal, surface waters and groundwater (§ 3 I WHG).
2. A permit of discharges of wastewater in waters is only to be granted, if the pollution input is minimised as a result of the emission standard 'Best Available Technique' (*Stand der Technik*) (§ 7a I WHG).

   The *Stand der Technik* is defined as the state of development of technically and economically applicable techniques, which are best suitable as best available techniques for the reduction of emissions at the source (§ 7a V WHG).

   The *Stand der Technik* is stated for each industry sector in the Ordinance of Waste Water (*Abwasserverordnung – AbwV*). These are minimum requirements, higher requirements due to aquatic environment specific quality immission status are possible (§ 5 I Nr. 1WHG), if the requirements are appropriate.

   To assess whether the *Stand der Technik* is applied, a waste water (whole effluent) assessment by using bioassays is carried out for 10-15 years. The whole effluent assessment by using a bioassay test-set allows to investigate the complex composition of the waste water, which is not possible by following the substance-specific approach. Moreover, it indicates the potential environmental hazard, which is also not possible by the substance-specific approach (see chapter E 4.4).

   In addition, pursuant to the Waste Water Charges Act (*Abwasserabgabengesetz*- AbwAG) a charge has to be paid for discharging waste water. The charge depends on the degree of pollution of the waste water. It is based on chemical analysis and on the use of bioassays.

3. For the handling of water-hazardous substances in plants and pipelines, special safety requirements are applicable (§§ 19a ff WHG). Water-hazardous substances are defined as 1. crude oils, petrol, diesel fuels and fuel oils and 2. other liquid or gaseous substances likely to contaminate waters or to adversely affect their properties in other ways. Such substances shall be defined by the Federal Government by way of a statute subject to the consent of the *Bundesrat*, which is the lower chamber comprised of *Länder* delegates (§ 19a II WHG). For identifying a substance as water-hazardous substance, bioassays are used.
4. As a tool against pollution due to diffuse sources it is possible to establish water protection areas. Water protection areas may be established where it is necessary, in the interests of the common interest, 1. to protect certain waters against detrimental effects in the interests of the existing or any future public water supply, 2. to replenish the stock of ground water, or 3. to prevent the harmful effects caused by rainwater run-off as well as by erosion and the introduction of soil components, fertilisers, herbicides and pesticides into waters (§ 19 WHG).

To summarise, the Water Management Act provides different measures to reduce emissions. Especially, the whole effluent assessment based on bioassays as an effective tool has to be emphasised. Measures to reduce pollution of diffuse sources especially caused by agriculture are difficult to control. That might be the reason, why Water Protection Areas are not established very often, except in areas used as drinking water sources (Vorreyer, 1996).

3.2.4 Plant Protection Act (PflSchG)

The Federal Plant Protection Act (*Pflanzenschutzgesetz* - PflSchG) has to be applied for all plant protection products (in the meaning of § 2 PflSchG) in Germany.

The protection of plants against disease and harmful organism is subject of the '*konkurrierende Gesetzgebung*', i.e. the *Länder* have the legislative competence so long as the Federal Parliament has not legislated in the respective area. However, legislation in this domain are strongly influenced by European regulations.

The purposes of the Plant Protection Act are amongst others: to avert dangers that may result from the use of plant protection products or other plant protection measures, especially those relevant to human and animal health and the natural balance, and to enforce legal instruments issued by the European Community in the field of plant protection (§ 1 Nr. 4 and 5 PflSchG).

To fulfil this purpose, the Act stipulates the authorisation of plant protection products for the market. The procedure for authorisation is established as follows: Plant protection products may be marketed or imported in the formulation envisaged for the sale to the user only if they have been authorised by the Federal Biological Agency (*Biologische Bundesanstalt* - BBA) (§ 11 I PflSchG). Since 1st of November 1996 978 pesticides with 256 active agents have been authorised (BBA, 1996).

The Federal Biological Agency grants authorisation of a plant protection product, if *inter alia* the following requirements are met: an examination of the plant protection product shows that, in the light of current scientific knowledge and technology, given its intended and proper use or as a result of such use, this product

a) is sufficiently effective,

b) has no unacceptable effect on plants or plant products to be protected,

c) does not cause unnecessary pain or suffering to vertebrates to be controlled by the plant protection product,

d) does not cause harmful effects on human and animal health nor on groundwater and

e) has no unacceptable effects, particularly on the natural balance as well as on the hormonal balance of man and animals (§ 15 I Nr. 3 PflSchG).

The ecotoxicological data included in the application for authorisation must be sufficient for an effect assessment on not-target organism by proper use (compare chapter E 4.4).

3.2.5 Law of Fertiliser (DMG)

The Law on the Use of Fertiliser and similar Substances (*Düngemittelgesetz* – DMG) regulates the trade and use of fertilisers.

Fertilisers are used for agriculture and forestry purposes, therefore the regulation of fertiliser in Germany is, as mentioned in the previous chapter, subject of the concurrent legislation.

The law intends to assist soil protection, as the permissibility of fertilisers is made contingent on whether, used appropriately, they present a threat to e.g. soil fertility or the balance of the natural environment (UBA, 1998 a). Furthermore, it enhances water protection against diffuse inputs of fertiliser (BMU, 1998).

To support soil and water protection the law prescribes the application of the 'Best Environmental Practice' (*gute fachliche Praxis*) (§ 1a DMG). The application of the 'Best Environmental Practice' includes that the type, amount and period of fertilisation is appropriate to the requirements of the plants and soil by considering the available nutrients in soil and site and culture conditions (§ 1 a II DMG).

A more concrete guideline for Best Environmental Practice is the Fertilisers Ordinance (*Düngemittel-Verordnung* - DüngemittelV), which is the implementation of the European Directive on Nitrate.

3.2.6 Chemicals Act (ChemG)

The regulation on chemical substances is of great importance as it regulates the major load of hazardous substances.

The Chemicals Act (*Chemikaliengesetz – ChemG*) has to be applied for all chemicals, which are not included in the EC Ordinance for the Evaluation and Control of Environmental Risks of Old Chemicals (*EG-Altstoffverordnung* – EG-AltstoffVO).

The chemical law is, as mentioned for the Plant Protection Act, subject of the concurrent legislation and is mainly influenced by European regulations.

The Chemicals Act intends to protect human beings and the environment against harmful effects of hazardous chemicals (substances and preparations) (§ 1 ChemG).

To ensure that the objective is reached, substances newly brought into circulation must be tested according to predetermined criteria for possible hazardous properties and effects. In addition, the substances must first be registered at the Federal Institute for Health and Safety at

Work (*Bundesanstalt für Arbeitsschutz*). Various federal agencies and institutions are involved in the testing and evaluation procedure: the Federal Institute for Consumer Health and Veterinary Medicine (*Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin* - BGvV), the Federal Environmental Agency (*Umweltbundesamt* - UBA), the Federal Biological Agency (*Biologische Bundesanstalt* - BBA) and the Federal Institute for Materials Testing (*Bundesanstalt für Materialprüfung*).

For the evaluation of possible hazardous properties to the environment, ecotoxicological testing is required (compare chapter E 4.4).

As measure to fulfil the objective, hazardous substances are to be classified, packaged and clearly marked according to the degree of risk inherent in these substances. This is subject to the Ordinance of Hazardous Substances (*Gefahrstoffverordnung* – GefStoffV). Further, the manufacture, processing and use of hazardous substances may also be subject to special conditions. Alongside new substances, substances already in circulation may also become subject to the requirements under the Chemicals Act if evidence of a particular risk becomes known.

Prohibitions and restrictions are possible on the basis of an Ordinance, the Ordinance of Prohibitions and Restrictions of Circulation of Hazardous Chemicals (*Chemikalienverbots-verordnung* – ChemVerbotsV). According to this Ordinance e.g. the use of tar oil in wood conservation agents is forbidden. E.g., the application of PCBs in closed systems as large electrical transformers has been prohibited. In addition, restrictions concerning the use of PCBs are regulated in ordinances, the Waste Oil Ordinance (*Altölverordnung* - AltölV) and the Ordinance on Sewage Sludge (*Klärschlammverordnung* – AbfKlärV) which belong to the Cycle Management and Waste Act (*Kreislaufwirtschafts- und Abfallgesetz* - KrW-/AbfG). Threshold values for PCBs in drinking water are stated in the Drinking Water Ordinance (*Trinkwasserverordnung* - TrinkwV), which belongs to the Foodstuffs Act (*Lebensmittel- und Bedarfsgegenständegesetz* - LMBG).

Of the 1086 substances registered in Germany to date (November 1998), 159 have achieved annual sales of 10 t, 18 of 100 t and only 3 of 1.000 t (UBA, 1998 b).

3.3 Dredged material management

The annual total amount of dredged material resulting from maintenance of Federal waterways in Germany adds up to ca. 40 million m³, with the main part resulting from dredging at the coast or tidal area. In addition, there are 29 larger single capital dredging projects in the Federal Waterways, where the amount of dredged material of one project is for instance ca. 10 Million m³. Furthermore, the states (*Länder*) of Germany have to tackle an annual amount of approximately 8 million m³ (Bertsch & Köthe, 1999). These figures clearly indicate that there is a need for regulations concerning dredged material management.

But the Federal Republic of Germany does not yet have a common, nation-wide regulation for the management of dredged material. For a better understanding of the existing regulations concerning dredged material management a short overview over the competencies concerning dredged material in the Federal Republic of Germany is given first.

3.3.1 Competencies

Construction of inland waterways and their maintenance are the competence either of the Federal Authorities, of those of the 16 *Länder*, or of the 16,099 municipalities.

For the Federal waterways (7.700 km) the Federal Ministry of Transport (*Bundesministerium für Verkehr* - BMV) and its subordinated authorities are responsible. Maintenance and development work on Federal waterways are planned and carried out by the Federal Waterways and Shipping Administration (*Wasser- und Schiffahrtsverwaltung des Bundes* - WSV) (see figure 3-3). Environmental aspects are covered by the Federal Institute of Hydrology (*Bundesanstalt für Gewässerkunde* - BfG), both by providing conceptual guidance and project monitoring (Köthe et al., 1998).

All other inland waterways are under the responsibility of the *Länder* according to the federal structure of the country. In general, dredging projects are managed at the municipal or regional level by the competent local or regional authority. Regulations concerning the media water, soil and waste, which may also be relevant when dealing with dredged material, are treated on a common and co-ordinated *Länder* level, in joint *Länder* Working Groups – for water (LAWA), soil (LABO) and waste (LAGA). Tasks concerning the environment which have to be solved on national level are the competence of the Federal Ministry for Environment, Nature Conservation and Nuclear Safety (*Bundesministerium für Umwelt, Naturschutz und Reaktorsichherheit* - BMU) with its associated agencies: the Federal Environmental Agency (*Umweltbundesam*t - UBA) and the Federal Agency for Nature Conservation (*Bundesamt für Naturschutz* - BfN) (Köthe et al., 1998).

3.3.2 International influence on German dredged material management

Germany is a Member State of the International Conventions for the protection of the marine environment, the London Convention (LC), the Oslo and Paris Convention (OSPARCON) for the protection of the Northeast Atlantic and the Helsinki Convention (HELCON) for the protection of the Baltic Sea (see chapter 4.2). In the framework of these conventions guidelines have been adopted concerning dredged material management in the marine area (see chapter 4.2.4). Germany as a contracting party is obliged to take these guidelines into consideration for any authorisation or regulation procedures for dredged material. It is, however, implicit that the detailed procedures described in the guidelines ca be adapted to national or local conditions (OSPARCOM, 1998 b).

In the framework of international conventions for the protection of rivers, like the International Commission for the Protection of the Rhine (ICPR), of the Elbe (ICPE, see chapter 5.2) and of the Oder (ICPO), river specific dredged material management guidelines are developed. For instance, the ICPR has issued recommendations for the evaluation of dredged material (ICPR, 1995) and criteria governing the relocation of dredged material in the Rhine (ICPR, 1997). The ICPR recommendations will be examined in more detail in chapter 4.3.

DREDGED MATERIAL MANAGEMENT			
Governing level	**Subject**	**Actor**	**Regulation**
Federal Government	Federal Waterways	• Federal Ministry of Transport • Federal Waterways and Shipping Administration • Federal Institute of Hydrology	• Directive for the Handling of Dredged Material on Federal Coastal Waterways • Directive for the Handling of Dredged Material on Federal Inland Waterways
Joint *Länder* Working Groups	River Catchment Area	e.g. ARGE Elbe	Recommendations for the Handling of Contaminated Dredged Material on River Elbe
Länder and municipalities	*Länder* water bodies	e.g. Government of Schleswig-Holstein	Dredged Material Management Concept

Figure 3-3: Dredged Material Management in Germany

3.3.3 German regulations concerning dredged material management

Germany has only few nation-wide regulations that are applicable in all its *Länder* for dredged material management (see figure 3-3). For the Federal waterways from the coastal waters up to the freshwater limit, the Directive for the Handling of Dredged Material on Federal Coastal Waterways (HABAK-WSV; BfG, 1999) is applied by the WSV. The HABAK-WSV constitutes an application of the HELCON, OSPARCON and LC guidelines on dredged material management. For the Federal waterways, which are upstream of the freshwater limit, the Directive for the Handling of Dredged Material on Federal Inland Waterways (HABAB-WSV; BfG, 1997) has to be used. The German Association for Water Pollution Control (ATV) has compiled a Memo M 362 Recommendation for the Handling of Dredged Material (1997) for German inland waters. However, this association did not have a political mandate for co-ordination between the *Länder*. Such a mandate was given by the Conference of *Länder* Ministers for the Environment to the *ad-hoc* Working Group on Dredged Material of the Working Group of the Elbe (*Arbeitsgemeinschaft Elbe* - ARGE Elbe), which consists of experts from the seven riparian *Länder* of the River Elbe and representatives of the Federal Authorities (Köthe et al., 1998). This working group issued the Recommendation for the Handling of Contaminated Dredged Material on River Elbe (ARGE Elbe, 1996; see also chapter 5.2). The recommendation also includes contaminant thresholds for the relocation of dredged material in the Elbe. Furthermore, at present the Federal/*Länder* Working Group on Coastal Dredged Material (*Bund/Länder Arbeitskreis Baggergut Küste* - BLABAK) works by commission of the Federal/*Länder* Committee 'North Sea and Baltic Sea' (*Bund/Länder Arbeitskreis -Nord-/ Ostsee* - BLANO) on Joint Recommendations for the Application of the Guidelines on Dredged Material of the OSLO and HELSINKI Conventions (Köthe et al., 1998).

Besides that, some *Länder* have issued their own guidelines and recommendations, e.g. *Schleswig-Holstein*, which also includes contaminant thresholds for the relocation of dredged material (SH 1996). In those *Länder,* which do not have specific regulations concerning dredged material management, other regulations like those relating to soils and waste are being used (Köthe et al., 1998).

Due to different competencies and different regulations, dredged material is valued and handled differently within Germany and there is a strong need for harmonisation (Köthe et al., 1998; Netzband, 1997).

The Directive for the Handling of Dredged Material on Federal Coastal Waterways (HABAK-WSV; BfG, 1999) and the Directive for the Handling of Dredged Material on Federal Inland Waterways (HABAB-WSV; BfG, 1997) are discussed in more detail in the next chapters. The focus will be on the use of bioassays, the evaluation of contamination and criteria for the decision on disposal options. Other German environmental laws, which can be relevant when dealing with dredged material, are as well addressed shortly.

3.3.4 Directive for the Handling of Dredged Material on Federal Coastal Waterways (HABAK-WSV)

The Directive for the Handling of Dredged Material on Federal Coastal Waterways (HABAK-WSV) (BfG, 1999) constitutes the dredged material guidelines in the framework of the international convention, LC, OSPARCON and HELCON. Therefore the basic management, like to prove the need for dredging, minimising the dredged material amount, characterisation of the dredged material, land-based or aquatic disposal options, permission and monitoring is congruent with the international guidelines and will be examined in detail in chapter 4.2.4.

The evaluation of dredged material is based on physical, chemical and biological characterisation. The chemical characterisation includes the analysis of substances listed in table 3-2 and 3-3. Depending on local pollution conditions, additional or fewer substances might have to be analysed. For the chemical evaluation of the dredged material there are two different concentration levels stated. They are, like the international guidelines have recommended, action levels. The first action level, the reference value (RW1) is based on the prevailing contaminant concentration in the North Sea Wadden sediments from 1982-1992. The second action level (RW2) is the result of five times the reference value for metals and three times for organic contaminants (IADC/CEDA, 1997 a). The action levels should only be taken as guide values. For its application the regional contamination and local peculiarities have to be considered (BfG, 1999).

Table 3-2: Action levels of metals in dredged material (sediment fraction < 20µm) pursuant to HABAK-WSV

Metal	Unit	Action level	
		Action level 1 (RW1)	Action level 2 (RW2)
Arsenic	mg/kg d.m.	30	150
Cadmium	mg/kg d.m.	2.5	12.5
Chromium	mg/kg d.m.	150	750
Copper	mg/kg d.m.	40	200
Lead	mg/kg d.m.	100	500
Mercury	mg/kg d.m.	1.0	5
Nickel	mg/kg d.m.	50	250
Zinc	mg/kg d.m.	350	1750

Table 3-3: Action levels on organic contaminants in dredged material (sediment fraction < 20µm) pursuant to HABAK-WSV.

Organic compound	Unit	Action level	
		Action level 1 (RW1)	Action level 2 (RW2)
PCB 28	µg/kg d.m.	2	6
PCB 52	µg/kg d.m.	1	3
PCB 101	µg/kg d.m.	2	6
PCB 118	µg/kg d.m.	3	10
PCB 138	µg/kg d.m.	4	12
PCB 153	µg/kg d.m.	5	15
PCB 180	µg/kg d.m.	2	6
Σ PCBs	µg/kg d.m.	20	60
α-hexachlorocyclohexane	µg/kg d.m.	0.4	1
γ- hexachlorocyclohexane	µg/kg d.m.	0.2	0.6
Hexachlorobenzene	µg/kg d.m.	2	6
Pentachlorobenzene	µg/kg d.m.	1	3
p,p'-DDT	µg/kg d.m.	1	3
p,p'-DDE	µg/kg d.m.	1	3
p,p'-DDD	µg/kg d.m.	3	10
Σ PAHs*	mg/kg d.m.	1	3
Σ HCs	mg/kg d.m.	300	1000
TBT	µg Sn/kg d.m.	nn	nn
DBT	µg Sn/kg d.m.	nn	nn
* Total of six PAH compounds: fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene			

In addition to the analysis of contaminants, nutrients, total phosphorus and total nitrogen have to be measured. The interim action level 1 (RW1) for solid and elutriates are:

action level 1 (RW1):	Total phosphorus	< 500 mg/kg d.m. or	< 2 mg/l elutriate
	Total nitrogen	< 1500 mg/kg d.m. or	< 6 mg/l elutriate

The biological characterisation also includes ecotoxicological studies, the use of bioassays. The international guidelines require a test-set of different bioassays (see chapter 4.2.4), but according to the HABAK-WSV normally only one bioassay, the bioluminescence inhibition test with *Vibrio fischeri*, is applied. It is argued that at present it is the only standardised test for which a national norm (DIN) exists (BfG, 1999). In some cases also not standardised tests are applied.

Due to that lack of validated marine bioassays in Germany, the project 'validation, harmonisation and implementation of a minimal biological test-set for the evaluation of marine water- and sediment samples' has the aim to fulfil the international requirements (Peters & Ahlf, 2000). It is funded by the Federal Environmental Agency (*Umweltbundesamt* - UBA). Besides the bioluminescence inhibition test, also the standardised marine algae test (DIN) and the acute amphipod test will be validated, harmonised and implemented.

The evaluation of the ecotoxicological test results in a sediment classification, which is summarised in table 3-4. If more than one test is used, the most sensitive organism should be considered.

Table 3-4: Ecotoxicological sediment classification pursuant to HABAK-WSV (translated into English)

Highest tier of dilution without effect	Class	Name of the toxicity class
origin sample	0	toxicity not provable
1:2	I	very low toxicity
1:4	II	low toxicity
1:8	III	moderate toxicity
1:16	IV	increased toxicity
1:32	V	high toxicity
1:64 and higher	VI	very high toxicity

The decision about the disposal option depends on the dredged material quality, in which three cases can be differentiated, as shown in table 3-5.

Table 3-5: Case decision depending on dredged material quality pursuant to HABAK-WSV (translated into English)

Case	Chemical criteria	Ecotoxicological criteria	Nutrients
1	The mean concentration c* of each single contaminant is below or equal to action level 1 (RW1): $c \leq RW1$	Toxicity class 0-II	The concentration of P_{total} and N_{total} is below or equal to action level 1 (RW1): $c \leq RW1$
2	The mean concentration c* of at least one contaminant exceeds action level 1 (RW1), but not action level 2 (RW2): $RW1 < c \leq RW2$	Toxicity class III-IV	The concentration of P_{total} and/or N_{total} is higher as action level 1 (RW1): $c > RW1$
3	The mean concentration c* at least of one contaminant is higher than action level 2 (RW2) $c > RW2$	Toxicity class V-VI	
* mean concentration over area, depth and time			

<u>Case 1:</u>

Dredged material with the properties listed in table 3-5 can be disposed at sea provided that no significant physical impacts are likely to be caused.

<u>Case 2:</u>

For dredged material with the properties listed in table 3-5 the following considerations and measures have to be done before disposal:

- weighing aquatic disposal against land disposal,
- if the source of pollution is known, demanding source-reduction,
- reducing the impact of disposal by technical measures,
- disposal at a limited period,
- preferring other, less sensitive disposal sites.

Disposal is allowed if the result of the impact hypothesis indicates that no considerable or sustainable harm to the mentioned subjects and uses and no considerable or sustainable accumulation of contamination or toxicological impact to sediment are expected. If this is not the case, management as in case 3 is required.

<u>Case 3:</u>

In addition to the considerations of case 1 and 2 the following factors have to be proved both for coastal disposal and land disposal:

- technical pre-treatment of the dredged material for minimising the effects of disposal to the marine environment,
- special disposal techniques and other process engineering measures,
- weighing impact to the marine ecosystem against terrestrial ecosystem,
- landscape use,
- no future use of the disposal sites,
- economic considerations.

If land disposal causes less impacts than aquatic disposal, aquatic disposal has to be avoided if possible. But case 3 does not inevitably lead to a prohibition of aquatic disposal. A decision has to be made for each individual measure and has to be documented by the responsible WSV. When dredged material is disposed in the aquatic ecosystem in case 3, the WSV or the BfG has to report annually according to the international conventions and has to initiate measures to reduce the adverse effects.

To summarise, according to the HABAK-WSV, the decision of the dredged material disposal is based on chemical and ecotoxicological action levels. The action levels can only be used as guiding values. At present only one bioassay is used for the ecotoxicological assessment. Depending on the quality of the dredged material three categories can be differentiated. But the decision is still flexible and can be taken on a case-by-case basis.

3.3.5 Directive for the Handling of Dredged Material on Federal Inland Waterways (HABAB-WSV)

Similar to the international guidelines on dredged material management (see chapter 4.2.4) and the HABAK-WSV the tiered procedure according to Directive for the Handling of Dredged Material on Federal Inland Waterways (HABAB-WSV) (BfG, 1997) includes: planning of the project, avoidance of dredged material; physical, chemical and if necessary ecotoxicological and ecological characterisation; relocation or direct beneficial use; pre-treatment and recovery on land or aquatic disposal besides the Federal waterways; and as the last option, disposal on land; examination of the disposal site and selection of the suitable option.

In the following, some aspects of the chemical and biological characterisation, and the criteria for the different management options will be highlighted.

The physical characterisation of the dredged material is compatible with international guidelines. The chemical parameters are basically the same as listed in the HABAK-WSV (see above). The only difference is, that iron and mineral oil will also be measured. According to the general programme, pentachlorobenzene, tributyltin (TBT) and dibutyltin (DBT) do not have to be measured. However, the programme can be adjusted to regional and local special conditions.

Ecotoxicological studies have to be conducted, if the chemical analysis and a biological structure analysis indicate that ecotoxicological effects might be possible and the option of relocation is not excluded because of the chemical analysis. According to the HABAB-WSV, the bioassays, which have to be applied in such cases, are in general porewater tests with bacteria (bioluminescence inhibition of *Vibrio fischeri*, algae (freshwater algae growth inhibition test) and crustacea (Daphnia toxicity test). In addition other tests are conducted in special cases.

The chemical and biological criteria for relocation of dredged material in the Federal waterways are summarised in table 3-6.

Table 3-6: Criteria for the decision of relocation according to HABAB-WSV

Chemical criteria and decision		
Case	**criteria**	**decision**
Case 1	The median concentration of each single contaminant in the dredged material does not exceed the 1.5 times value of the median concentration of contaminants of the suspended matter (3-annual-median) at the relocation site.	The dredged material can be relocated.
Case 2	The median concentration of at least one contaminant in the dredged material exceeds the 1.5 times value but none exceeds the 3 times value of the median concentration of contaminants of the suspended matter (3-annual-median) at the relocation site.	The decision about relocation has to be proved in every single case. Inputs of pollution into the water body have to be considered. In addition the ecotoxicological assessment of the dredged material can be considered.
Case 3	The median concentration of at least one contaminant in the dredged material exceeds the 3times value of the median concentration of contaminants of the suspended matter (3-annual-median) at the relocation site.	It is not allowed to relocate the dredged material in principle.
Biochemical criteria		
The relocation must not cause an oxygen consumption in the water body below 4mg/l.		
Ecotoxicological criteria		
Case 1	Porewater of the dredged material in a dilution of 1:4 does not causes toxicological effects.	The dredged material can be relocated.
Case 2	Porewater of the dredged material in a dilution of 1:4 causes toxicological effects.	A case-by-case decision will be made, further ecotoxicological studies might be necessary.
Ecological criteria		
Negative effects on the benthos has to be avoided. The extent of acceptable effects has to be decided on a case-by-case basis.		

Relocation is the most economic (BfG, 1997) and in Germany the most common (HH, 1999) disposal option.

The relevant regulations concerning dredged material management are shown in figure 3-4.

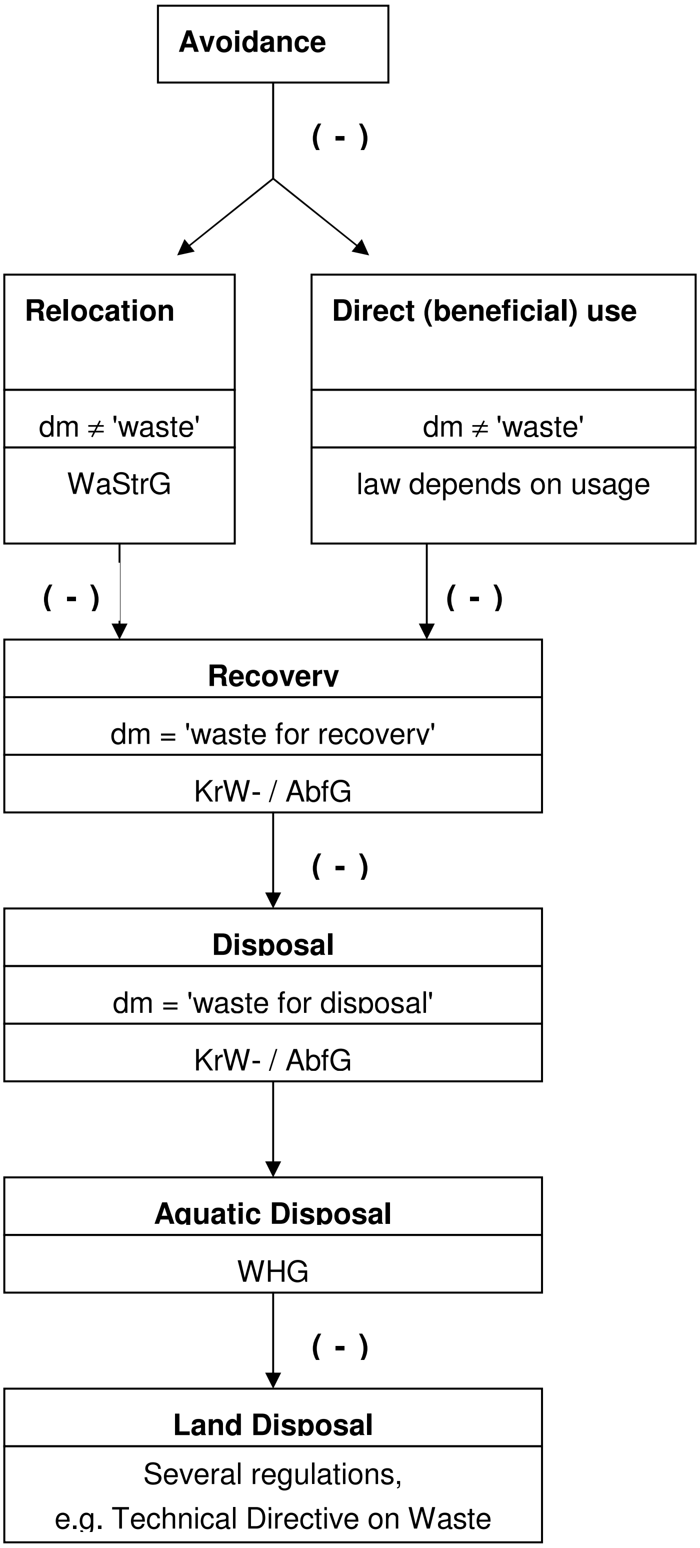


Figure 3-4: German regulations for dredged material management besides HABAK-WSV and HABAB-WSV and Länder dredged material guidelines (dm = dredged material).

In cases of relocation of dredged material in Federal waterways, the Federal Waterway Act (*Bundeswasserstraßengesetz* – WaStrG) has to be considered. For maintenance dredging no permission is necessary (§ 7 III WaStrG), but in case that interests of the *Länder* are affected, they have to give their consent to such actions (*Einvernehmen*) (§ 4 WaStrG).

In addition, the Federal Nature Conservation Act (*Bundesnaturschutzgesetz* – BNatSchG) has to be considered. Pursuant to § 3 III 2 BNatSchG the other authorities shall inform and consult the authorities in charge of conservation of nature and of landscapes as early as in the preparatory stages of any public plans or measures which may affect the interests of nature and landscape conservation. If the dredging operation causes encroachments on nature and landscapes, as defined in the BNatSchG, compensation or substitution measures have to be carried out (§ 8 I, II, VI and IX BNatSchG).

In parallel to the relocation option it should be proved, whether the dredged material might be directly used (without technical treatment).

If the dredged material cannot be relocated or used directly, than the dredged material can in general be assumed to constitute 'waste' in the sense of the Cycle Management and Waste Act (*Kreislaufwirtschafts- und Abfallgesetz* - KrW-/AbfG). The word 'waste' is defined in the KrW-/AbfG as all movable property that falls within one of the groups listed in Annex 1 and which the owner disposes of, wishes to dispose of or must dispose of. 'Waste for recovery' is waste that is recycled; waste that is not recycled is 'waste for disposal' (§ 3 I KrW-/AbfG).

Although dredged material is not directly mentioned in Annex 1, it can be assumed that it fits to the subject 'other properties' (BfG, 1997). If the dredged material cannot be relocated or directly used, then in general also one of the three alternatives of disposal is fulfilled.

If the dredged material is waste in the sense of KrW-/AbfG, the basic principles of the KrW-/AbfG must be applied: avoidance, recovery and disposal (§ 4 KrW-/AbfG).

For recovery of dredged material, a treatment is necessary. There are in general different treatment techniques possible (see HABAB-WSV). Several regulations regarding recovery exist, which have to be considered depending on the purpose, e.g. for agriculture and forestry use the technical guidelines of the *Länder* Working Group Soil (LABO) and the Ordinance on Sewage Sludge (*Klärschlammverordnung* – AbfKlärV). For more details see HABAB-WSV or Bertsch & Köthe (1996 & 1999).

For land disposal of dredged material, several regulations, e.g. the Technical Directive on Waste Disposal (*TA-Abfall*) have to be applied (HABAB-WSV).

Aquatic disposal is part of the Water Management Act (*Wasserhaushaltsgesetz* – WHG) and its implementation by the *Länder*. For any aquatic disposals a permit or concession is necessary (§ 2II Nr.6 WHG). Generally, solid matter shall not be introduced into waters for the purpose of disposal. However, sludge and dredged material shall not be deemed to be solid matter. Substances may only be stored or deposited near waters if this is done in such a way that no pollution of the water or any other detrimental change in the properties of the water or in water flow is caused (§ 26 I, II WHG).

To summarise, the German dredged material management consists of a complex system of regulations. The Federal approach, stated by the HABAK-WSV and HABAB-WSV is not based on environmental quality objectives but on prevailing contaminant concentration and therefore a prohibition of deterioration is stated. The Federal and *Länder* regulations differ in their evaluation of contamination of dredged material that results in different disposal strategies. There is a strong need for a harmonised, nation-wide regulation (Netzband 1997; Köthe et al. 1998).

References

ARGE Elbe (1996): Umgang mit belastetem Baggergut an der Elbe – Zustand und Empfehlungen. Ad-hoc AK Baggergut, Wassergütestelle Elbe. Hamburg.

Abwasserabgabengesetz (AbwAG) in der Fassung der Bekanntmachung vom 3.11.1994. BGBl. I, p. 3370, zuletzt geändert durch G v. 25.8.1998, BGBl. I, p. 2455.

Abwassertechnische Vereinigung (ATV) (1997): Umgang mit Baggergut. Merkblatt ATV-M 362. Hennef.

Abwasserverordnung (AbwV) in der Fassung der Bekanntmachung vom 9. 2.1999. BGBl. I, p. 86.

Beck Verlag (1988): Grundgesetz mit Deutschlandvertrag, Grundvertrag, Menschenrechts-Konvention, Bundeswahlgesetz, Bundesverfassungsgerichtsgesetz, Parteiengesetz und Gesetz über den Petitionsausschuß, Beck.

Bertsch, W. & Köthe; H. (1996): Beurteilungskriterien für die Verwendung, Verwertung, Landlagerung und Beseitigung von belastetem Baggergut. In: Hösel, G., Bilitewski, B., Schenkel, W. & Schnurer, H. (Eds.): Müll-Handbuch. Erich Schmidt Verlag.

Bertsch, W. & Köthe; H. (1999): Von Flußsedimenten und Hafenschlämmen zu Baggergut. In: Hösel, G., Bilitewski, B., Schenkel, W. & Schnurer, H. (Eds.): Müll-Handbuch. Erich Schmidt Verlag.

Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA) (1996): Jahresbericht 1996. BBA. Braunschweig.

Bürgerschaft der Freien und Hansestadt Hamburg (HH) (1999): Mitteilung des Senats an die Bürgerschaft – Sicherung der Unterbringung des Baggergutes aus Hafen und Elbe. Drucksache 16/3080.

Bundesanstalt für Gewässerkunde (BfG) (1997): Handlungsanweisung für den Umgang mit Baggergut im Binnenland (HABAB-WSV). BfG Nr. 1070.

Bundesanstalt für Gewässerkunde (BfG) (1999): Handlungsanweisung für den Umgang mit Baggergut im Küstenbereich (HABAK-WSV). 2. überarbeitete Fassung. BfG Nr. 1100.

Bundesministerium Für Umwelt, Naturschutz Und Reaktorsicherheit (BMU) (1998): Umweltpolitik – Wasserwirtschaft in Deutschland. Bonn.

Bundesnaturschutzgesetz (BNatSchG) in der Fassung der Bekanntmachung vom 21. 9. 1998, BGBl. I, p. 2994. (The translation into English has been done in following the translation by the University of Bremen, so far the parts were still actual.)

Bundeswasserstrassengesetz (WaStrG) in der Fassung der Bekanntmachung vom 23.8. 1990. BGBl. III, p. 940-949.

(BLAK QZ) (1997): Bund-/Länder-Arbeitskreis 'Qualitätsziele'. Zielvorgaben zum Schutz oberirdischer Binnengewässer. Band I. Länderarbeitsgemeinschaft Wasser (LAWA) (Eds.). Berlin.

(BLAK QZ) (1998a): Bund-/Länder-Arbeitskreis 'Qualitätsziele'. Zielvorgaben zum Schutz oberirdischer Binnengewässer. Band II. Länderarbeitsgemeinschaft Wasser (LAWA) (Eds.). Berlin.

(BLAK QZ) (1998b): Bund-/Länder-Arbeitskreis 'Qualitätsziele'. Zielvorgaben zum Schutz oberirdischer Binnengewässer. Band III. Länderarbeitsgemeinschaft Wasser (LAWA) (Eds.). Berlin.

Chemikaliengesetz (ChemG) in der Fassung der Bekanntmachung vom 25. 7. 1994. BGBl. I p. 1703, zuletzt geändert durch G 14.5.1998, BGBl. I, p. 950.

Chemikalienverbotsverordnung (ChemVerbotsV) in der Fassung der Bekanntmachung vom 19.7.1996. BGBl. I, p. 1151, zuletzt geändert durch VO v. 22.12.1998, BGBl. I, p. 3956.

Claussen, U. & Irmer, U. (1996): Umweltqualitätsziele und Umwelthandlungsziele im Gewässerschutz. In: Umweltbundesamt (Ed.), Texte 63/96. Berlin.

Council of the EC (European Communities) (1994): EU-Directive 76/769/EEC, Official Journal of the European Communities, No. L 365, Brussels.

Council of the EC (1993): EU-Directive 93/12/EC, Official Journal of the European Communities, No. L 74, Brussels.

Council of the EC (1987): EU-Directive 85/210/EEC, Official Journal of the European Communities, No. L 225, Brussels.

Düngemittelgesetz (DMG) vom 15. 11.1977. BGBl. I, p. 2134, zuletzt geändert durch G v 27.9.94, BGBl. I p. 2705.

Engelhardt, H, & Schlicht, J. (1997): Bundesimmissionsschutzgesetz – BImSchG – Kommentar. Köln.

Enquete-Kommission (1994): Die Industriegesellschaft gestalten – Perspektiven für einen nachhaltigen Umgang mit Stoff- und Materialströmen. Enquete-Kommission 'Schutz des Menschen und der Umwelt – Ziel und Rahmenbedingungen einer nachhaltig zukunftsverträglichen Entwicklung', Bonn.

Federal Environmental Agency (UBA) (1997): Daten zur Umwelt – Der Zustand der Umwelt in Deutschland, Berlin.

Gefahrstoffverordnung (GefStoffVO) vom 26.10.1993. BGBl. I, p. 1782, ber. p. 2049, zuletzt geändert durch VO v. 27.1.1999, BGBl. I, p. 50.

Gregor, H.-D. (1994): Umweltqualitätsziele, Umweltqualitätskriterien und -standards. In: Umweltbundesamt (Ed.), Texte 64/94. Berlin.

Holzwarth, F.; Radtke, H.; Hilger, B.; Bachmann, G. (2000): Bundes-Bodenschutzgesetz – Bundes-Bodenschutz- und Altlastenverordnung. Handkommentar. Bodenschutz und Altlasten Band 5, Berlin.

Internationale Kommission zum Schutz des Rheins (ICPR/ IKSR) (1995): Baggergutbewertung. IKSR Nr. 68.

Internationale Kommission zum Schutz des Rheins (ICPR/ IKSR) (1997): Empfehlung zu den Kriterien für die Umlagerung von Baggergut in den Rhein und seine Nebengewässer. IKSR Nr. 89.

Jarass, H.D. (1999): Bundes-Immissionsschutzgesetz – BImSchG – Kommentar. München.

Klärschlammverordnung (AbfKlärV) vom 15.4.1992. BGBl. I, p. 912, geändert durch VO v. 6.3.1997, BGBl. I, p. 446.

Köthe; H.; Bergmann, H., Bertsch, W., Heininger, P. & Keller, M. (1998): Long-term prospects for a common directive on dredged material in Germany. Bundesanstalt für Gewässerkunde (BfG).

Kramer, F. (2000): German Ministry of Environment, personal communication, July 3, Bonn.

Kreislaufwirtschafts- und Abfallgesetz (KrW-/AbfG) vom 27.9.1994. BGBl. Teil I, S. 2705, zuletzt geändert durch G v. 25.8.1998, BGBl. Teil I, S. 2455. (The translation into english has been done in following the translation by the University of Bremen, so far the parts were still actual.)

Landesregierung Schleswig-Holstein (SH) (1996): Baggergutkonzept der Landesregierung. Kiel.

Ministry of Environment (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)): personal communication, July 10, Bonn.

Netzband, A. (1997): Umgang mit Baggergut im Bereich der deutschen Nordseeküste. Hansa International Maritime Journal, 134 (12), p. 63-66.

Peters, C. & Ahlf, W. (2000): The necessity of a marine bioassay test-set to assess marine sediment quality and its approach. In: Workshop Report 'River Sediments and Related Dredged Material in Europe- - Scientific Background from the Viewpoints of Chemistry, Ecotoxicology and Regulations'. J. Gandrass et al. (eds.). April 3rd 2000, GKSS Research Centre, Germany.

Pflanzenschutzgesetz (PflSchG) in der Fassung der Bekanntmachung vom 14.5.1998. BGBl. I, p. 971, ber. p. 1527, 3512. (The translation into English is done according to the non-official translation of the *Biologische Bundesanstalt für Land- und Forstwirtschaft* (BBA)).

Queitsch, P. (1999): Bundes-Bodenschutzgesetz – umfassende Kommentierung. Köln.

Umweltbundesamt (UBA) (1998 a): Fertilisers Act. Internet. Last update: May 08,1998.

Umweltbundesamt (UBA) (1998 b): Chemicals Act. Internet. Last update Dec. 11, 1998.

Umweltbundesamt (UBA) (1999): Beispiele für Umweltqualitätsziele und Umwelthandlungsziele in ausgewählten Themenbereichen. Internet – Stand 18.02.1999.

Vorreyer, C. (1996): Beurteilung und Bewertung der Wirkung von Pflanzenschutzmitteln auf den Naturhaushalt. In: Koch, H.-J. & Lagoni, R. (Eds.). Meeresumweltschutz für Nord- und Ostsee. p. 273-279.

Wasserhaushaltsgesetz (WHG) in der Fassung der Bekanntmachung vom 12.11.1996. BGBl. I, p. 1695, zuletzt geändert durch G c. 25.8.1998, BGBl. I, p. 2455. (The translation into English has been done in following the translation by the University of Bremen, so far the parts were still actual.)

4 The European and international policy framework

Various agreements and organisations directly or indirectly influence the management of dredged material in the area of the North Sea. But the impacts of codes, agreements, decisions, declarations or recommendations are heavily influenced by whether or not they are binding in law (see table 4-1). Moreover, even if they are binding under international law, as for example the OSPAR agreements and decisions, the contracting parties cannot be sanctioned if they fail to fulfil the obligations. Nations that violate agreements within the European Water Framework Directive (EU-WFD) can be charged only due to European law by the European Court of Justice (see table 4-1).

Table 4-1: International Agreements and Organisations which influence the management of dredged material in the North Sea

Agreement or organisation	Legally binding	Non-binding in law (principle)	Imposition of sanctions if contracting parties fail to fulfil
European Water Framework Directive (EU-WFD) 2000	*		yes
International Maritime Organization (IMO) 1958	agreement (due to international law)	recommendation	no
London Convention 1972	agreement (due to international law)	recommendation	no
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) 1992	agreement and decisions (due to international law)	recommendation	no
Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCON) 1992	agreement (due to international law)	recommendation	no
International Conference on the Protection of the North Sea (first held in 1984)		*	no
International Council for the Exploration of the Sea (ICES) 1902		*	no
Permanent International Navigation Association (PIANC) 1885		*	no
Central Dredging Association (CEDA)		*	no
International Commission of the Protection of the Rhine (ICPR) 1963		*	no
International Association of Ports and Harbors (IAPH) 1955		*	no

4.1 European policy framework

In the 90s it was determined in Europe that the waters in the community were under increasing pressure from the continuous growth in demand for sufficient quantities of good quality water for all purposes. Moreover, as set out in Article 174 of the Treaty, the European Community policy on the environment was to contribute to pursue the objectives of preserving, protecting and improving the quality of the environment, and to be based on the precautionary principle and on the principles that preventive action should be taken, environmental damage should, as a priority, be rectified at source and that the polluter should pay (European Community, 1997).

During the discussion process of a European Water Framework Directive, it was stated that further integration of protection and sustainable management of water into other community policy areas such as energy, transport, agriculture, fisheries, regional policies and tourism was necessary. Common definitions of the status of water in terms of quality, and if relevant for quantity, should be established. Environmental objectives should be set to ensure that a good status of surface water and groundwater was achieved at community level.

Moreover, this framework should be a contribution towards enabling the member states to meet the obligations of various international agreements of the protection of marine waters from pollution, for example HELSINKI 1974, PARIS 1974 and the United Nations Convention on the protection and use of transboundary water courses and international lakes, approved by Council Decision 95/308/EC (Council of the EC, 1999).

4.1.1 The European Water Framework Directive

In June 2000 the European Parliament and the European Council adopted the European Water Framework Directive (EU-WFD). The purpose of the Water Directive is to establish a framework for the protection of inland surface water, transitional waters, coastal waters and groundwater that prevents further deterioration and protects and enhances the status of aquatic ecosystems with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems. Specific measures for the reduction or phasing out of discharges, emissions and losses of priority hazardous substances should be developed. The objectives of relevant international agreements, as for example to prevent the pollution of the marine environment, should be achieved (Article 1). A sufficient supply of good quality surface water and groundwater should be guaranteed as needed for sustainable, balanced and equitable water use. For heavily modified and artificial bodies, less stringent environmental objectives are required, when improvements in status would be infeasible or unreasonably expensive (Article 4 and Annex II of the EU-WFD) (see appendix 4.1.1 a). Concerning priority hazardous substances concentrations near background values for naturally occurring substances and close to zero for man-made substances should be the ultimate aim (Article 1and 16) (see Chapter 4.2.1.3). These objectives have to be achieved at the latest 15 years after the date of entry into force of this directive (Article 1 and 4) (European Parliament/Council, 2000).

Member states shall assure that a river basin covering the territory of more than one member state is assigned to an international river basin district. For these districts existing structures stemming from international agreements should be used (Article 3). All member states have to analyse for each river basin district its characteristics (European Parliament/Council, 2000). In this context the International Commission for the Protection of the Rhine (ICPR) may get an important role in the European water policy (see chapter 4.3).

A review of the impact of human activity on the status of surface waters and on groundwater as well as an economic analysis of water use has to be done (Article 5). Monitoring programmes for the ecological and chemical status of surface waters and the chemical and quantitative status of groundwater have to be operational at the latest six years after the date of entry into force of this Directive (Article 8).

Member states shall take account of the principles of recovery of the costs of water services, including environmental and resource costs, in accordance in particular with the polluter pays principle (Article 9). The emission controls have to be based on 'Best Available Technique'. Yet in the case of diffuse impacts the controls include 'Best Environmental Practices'. Moreover emission limit values have to be defined at the latest 13 years after the date of entry into force of this directive (Article 10) (Annex IX of the EU-WFD) (see appendix 4.1.1 b) (Council of the EC, 1999; European Parliament/Council, 2000).

Each programme shall include the following basic measures which are minimum requirements (Article 11):

For point and diffuse sources discharges liable to cause pollution, a requirement for prior authorisation, or registration based on general binding rules, laying down emission controls for the pollutants concerned. These controls shall be periodically reviewed and, when necessary, updated. The pollution of marine waters should not increase. Measures to eliminate pollution of surface waters by substances of the priority list should be developed.

- The programs of measures shall be established at the latest nine years after the date of entry into force of this directive.
- The programs of measures shall be reviewed, and if necessary updated at the latest 15 years after the date of entry into force of this directive and every six years later (European Parliament/Council, 2000).

Member states shall ensure that a river basin management plan is produced for each river basin district lying entirely within their territory. In the case of an international river basin district member states shall ensure co-ordination with the aim of producing a single international river basin management plan (Article 13 and 3). This statement may improve the importance of the ICPR to develop a sustainable river basin management in Europe (see chapter 4.3).

The EU-Parliament and the Council shall adopt specific measures against pollution of water by individual pollutants or groups of pollutants presenting a significant risk to or via the aquatic environment, including such risks to waters used for the abstraction of drinking water. Priority hazardous substances shall be reduced by ceasing or phasing out discharges, emissions and losses (Article 16) (European Parliament/Council, 2000):

- The European Commission shall submit a proposal setting out a first priority list of substances. Substances shall be prioritised for action on the basis of risk to or via the aquatic environment, identified by risk assessment or targeted risk-based assessment focusing on aquatic ecotoxicity and human toxicity (Annex VIII and X of the EU-WFD) (see appendix 4.1.1 c). In order to meet the time-table a simplified risk-based assessment, or a monitoring of widespread environmental contamination of substances will be accepted.

- The Commission shall review the adopted priority list at the latest four years after the date of entry into force of this directive and at least every four years thereafter.
- For the substances on the priority list, the commission shall submit proposals for controls on the cessation or phasing out of discharges, emissions and losses.
- The Commission shall submit proposals for quality standards applicable to the concentrations of the priority substances in surface water (Annex V of the EU-WFD) (see appendix 4.1.1 d).

The following shall be repealed with effect from 7 years after the date of entry into force of this Directive: Directive 75/440/EEC (quality of surface water abstracted for drinking water), Council Decision 77/795/EEC (exchange of information on the quality of surface freshwater), Council Directive 79/869/EEC (methods of sampling and analysis of surface water abstracted for drinking water). The following shall be repealed with effect from 13 years after the date of entry into force of this Directive: Council Directive 78/659/EEC (quality of freshwater to support fish life), Council Directive 79/923/EEC (quality required for shellfish waters), Council Directive 80/68/EEC (protection of groundwater against pollution caused by dangerous substances), Directive 76/464/EEC (with the exception of Article 6, which shall be repealed by this directive). The following transitional provisions shall apply for Directive 76/464/EEC: the priority list adopted under Article 16 of this directive shall replace the priority list of 1982. For bodies of surface water a minimum, give effect to quality standards at least as stringent as those required to implement Directive 76/464/EEC (Article 21) (Council of the EC, 1999).

Member states shall determine penalties applicable to breaches of the national provisions adopted pursuant to this directive (Article 22).

Europeans NGOs (BirdLife International, the European Environmental Bureau, Greenpeace, Seas at Risk, the UK Wildlife Trusts, and WWF) criticised the common position of the European Water Framework Directive. The most important arguments were as follows (Lanz et al., 2000).

The NGOs and the European Parliament propose to establish and maintain a complete list of all hazardous substances and not only an arbitrary number of substances, i.e. 32 published in the first 'priority list'.

A failure "*to aim to achieve*" to prevent further deterioration in the status of aquatic ecosystems (Article 1) would be difficult to prove. The Community would have no clear legal means of holding Member States to account for any failure to protect water effectively.

Member states are only required to take action in practice against groundwater pollution after a significant and long-term-upward-trend in the concentration of pollutants in groundwater had already occurred. This means that the damage has occurred before action is required (Lanz et al., 2000).

As long as no European threshold for water pollutants exists, the member states are allowed to define national policies to reduce water pollution. The principle of the recovery of the costs of water services, including environmental and resource costs was successfully rejected by Ireland. In the end agreement was reached that the water price at least has to cover the operational costs.

Within the EU-WFD it is possible to designate a surface water as heavily modified and changes of it would affect, for example, navigation or human development. If a river is defined as heavily modified less stringent environmental objectives have to be fulfilled.

4.1.2 Regulations concerning dredged material management

The European Union does not provide special regulations concerning dredged material management. Dredged material is from a European legal point of view considered as waste, the management of sediments as a resource is in comparison to international regulations neglected (see chapter 4.2).

The Council Directive on Waste (75/442/EEC) defines 'waste' as "*any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard*" (Art 1 (a)). Annex I of the Waste Catalogue (94/3/EC) similarly lists 'dredging spoil'. So if also one of the three facts of discard is fulfilled, than dredged material is waste.

Inherent in European Waste Law is a hierarchy of action: avoidance, reduction, recovery and disposal. However, dredged material cannot be avoided. The amount of dredged material can partly be reduced by treatment, e.g. by separation of the contaminated fraction from the clean fraction. The clean fraction can than either be relocated or beneficially used. But it is not possible to reduce the quantities by a significant amount (Baumert, 2000).

At present there is only one waste code for dredged material without distinction as to the origin of dredged material or its contamination. Baumert (2000) demands such a classification and refers to proposals for this item by Germany to the Technical Advisory Committee, which lays down technical rules based on the Council Directive on Waste (75/442/EEC).

According to Article 4 of the Waste Directive the member states shall take the necessary measures to ensure that waste is disposed of without endangering human health and without harming the environment, and in particular:

- without risk to water, air, soil and plants and animals,
- without causing nuisance through noise or odours,
- without adversely affecting the countryside or places of special interest.

One beneficial use option is the dispersal of material on agricultural land. The EC Directive on the Protection of the Environment, and in Particular of the Soil, when Sewage Sludge is Used in Agriculture (86/278/EEC) is similarly applied to the use of dredged material in agriculture (IADC/ CEDA, 1997a & 1997b).

Since June 1999 the Council Directive on the Landfill of Waste is in force (1999/31/EC). The preamble to this Directive states that its rules are not appropriate for dealing with dredging material, and calls on the European Commission to submit proposals for this sector.

Moreover there is a governmental Dutch-German-Exchange about Criteria for the Handling of Dredged Material. This might be a promoter to put dredged material management on the agenda of the EU in the future.

4.2 International marine policy framework

4.2.1 Introduction to organisations and conventions

The International Maritime Organization (IMO), established in 1958, was mainly focused on maritime safety and the efficiency of navigation. The first global convention, dealing with the control of marine pollution caused by a wide variety of substances, was the London Convention in 1972. Regional agreements for the protection of the marine environment of the North-East Atlantic have been the OSLO Convention in 1972 and the Paris Convention in 1974, replaced 1992 by the OSPAR Convention. The Helsinki Convention of 1974, issued to protect the marine environment of the Baltic Sea, was the first international agreement to cover all sources of pollution.

Important are also the Conferences on the Protection of the North Sea, which deal with the protection of the marine environment in the North Sea states through their declarations. In addition several organisations are concerned with marine and fisheries science, the management of waterways and ports, which influence the management of dredged material.

4.2.1.1 International Maritime Organization (IMO)

IMO (International Maritime Organization) entered into force 1958. Today IMO has 158 Member States and two Associate Members (IMO, 2000). The objectives of the organisation are:

- to intensify co-operation among governments and regulations relating to technical matters of all kinds affecting shipping engaged in international trade;
- to encourage and facilitate the adoption of the highest standards concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships.

IMO is a technical organisation and most of its work is carried out in a number of committees and sub-committees. The Maritime Safety Committee (MSC) is the most senior of these. It has a number of sub-committees dealing with: Safety of Navigation, Radiocommunications and Search and Rescue, Training and Watchkeeping, Carriage of Dangerous Goods, Solid Cargoes and Containers, Ship Design and Equipment, Fire Protection, Stability and Load Lines and Fishing Vessel Safety, Flag State Implementation and Bulk Liquids and Gases. The Marine Environment Protection Committee (MEPC) co-ordinates the IMO activities concerning the prevention and control of pollution of the marine environment from ships. The Legal Committee is responsible for considering any legal matters within the scope of the organisation. The Technical Co-operation Committee co-ordinates the provision of technical assistance in the maritime field, in particular to the developing countries. The Facilitation Committee deals with the facilitation of international maritime traffic (IMO, 2000).

Its first task was to adopt a new version of the International Convention for the Safety of Life at Sea (SOLAS), the most important of all treaties dealing with maritime safety, achieved in 1960. In the following years IMO was concerned with the facilitation of international maritime traffic, load lines and the carriage of dangerous goods. Pollution prevention was part of the original objectives but in the late 1960s a number of major tanker accidents initiated further actions.

During the next years IMO introduced a series of measures designed to prevent accidents and to minimise their consequences. It also tackled the environmental threat caused by routine operations such as the cleaning of oil cargo tanks and the disposal of engine room wastes. The most important of all these measures was a treaty usually known as MARPOL 73/78 - it was adopted in two stages, in 1973 and 1978. It covers not only accidental and operational oil pollution but also pollution by chemicals, goods in packaged form, sewage and garbage. IMO was also given the task of establishing a system for providing compensation to those who had suffered financially as a result of pollution. Two treaties were adopted, in 1969 and 1971, which enabled victims of oil pollution to obtain compensation much more simply and quickly than had been possible before (IMO, 2000).

In 1992 a further advance was made when the Global Maritime Distress and Safety System became operative. When it is fully in force in 1999, it will mean that a ship that is in distress anywhere in the world can be virtually guaranteed assistance, even if its crew does not have time to radio for help, as the message will be transmitted automatically.

Other measures introduced by IMO have concerned the safety of containers, bulk cargoes, liquefied gas tankers and other ship types. Special attention has been paid to crew standards.

Around 40 conventions and protocols have been adopted by the IMO and most of them have been amended on several occasions to ensure that they are kept up to date with changes taking place in world shipping. But the codes and recommendations are not binding on the Member Governments. Implementation of the conventions varies considerably from country to country (IMO, 2000).

In the scope of marine environmental protection, IMO is not only active through its own conventions and protocols but also has an observer status in several marine protection conventions. IMO's proposal for the out-phasing and subsequent ban of TBT as anti-fouling agent in ship paints is discussed in detail in chapter 4.2.3.4.

4.2.1.2 The London Convention (LC)

The convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, known as London Dumping Convention 1972, was the first global convention to be established for the control of marine pollution caused by a wide variety of substances. The control mechanism was based on the complete prohibition of the disposal at sea of particular harmful substances and the establishment of licensing systems for the disposal at sea of all other substances (see appendices 4.2.1.2a, 4.2.1.2b, 4.2.1.2c). Attempts were made to minimise the harmful effects of disposal by guidance to contracting parties, concerning the selection of disposal sites, disposal techniques and monitoring programmes. These procedures have also been effective in promoting the control of all sources of marine pollution and the value of a comprehensive waste management approach. Nevertheless disposal at sea will probably continue to be considered a practicable option (IMO, 1991).

Each party has the right to adopt other or more stringent measures, in accordance with the principles of international law, to prevent disposal at sea. Consultative meetings of the contracting parties should take place every two years, where amendments to the convention may be adopted by a two-thirds majority of those present.

The Convention came into force in 1975. The contracting parties decided that the International Maritime Organization (IMO) was to be responsible for secretariat duties in relation to the

Dumping Convention. In 2000, 78 states had ratified the London Convention (see appendix 4.2.1.2 d).

The responsibility and liability of a state for damage to the environment of other states or to any other area of the environment was recognised in accordance with the principles of international law. The contracting states had a duty to enforce the convention within their jurisdiction. Enforcement on the high seas however, lies primarily with the flag state of the disposal vessel (IMO, 1997a).

The reluctance to develop and adopt legally binding protocols for the prevention and control of marine pollution from land-based sources should be considered in the light of the far-reaching economic implications they would have for the industries, municipalities and agriculture of the prospective parties (IMO, 1991).

The 11th Meeting of the convention agreed that there were no fundamental inconsistencies between the United Nations Convention on the Law of the Sea (UNCLOS) 1983 and the London Dumping Convention. The contracting parties were free to apply the London Dumping Convention not only in its territorial waters but also in the 'Exclusive Economic Zone' and onto its continental shelf. The convention encourages contracting parties with common interests, in a given geographical area to enter into regional agreements.

The amendments in 1989 require that consideration be given to whether there is sufficient scientific information available to assess the impact of disposal before any permits are issued. The note of caution implicit in this amendment is indicative of the way attitudes towards the use of the sea for disposal purposes were changing. In the early 1970s it was generally assumed that disposal at sea was a permissible waste disposal option providing certain safeguards were met. By the 1980s some authorities – and contracting parties to the Convention itself – were beginning to doubt the wisdom of using the oceans in this way (IMO, 1997b). The opposition to incineration at sea had become so strong that in 1991 incineration at sea ceased (IMO, 1997a).

Although in 1985 experts concluded that the disposal of low-level radioactive waste was not environmentally dangerous an Inter-governmental panel of experts from contracting parties was established due to the increasing public opinion against the use of the sea as a dump for any sort of radioactive materials. It concluded that the states increasingly prohibited radioactive waste disposal at a regional level but increasingly disposed these materials in the international sea area (IMO, 1997a). In 1990 a resolution was adopted calling for the disposal of industrial wastes to cease by the end of 1995 (IMO, 1997a).

In 1996 the last amendments were made, but the 1996 Protocol has not yet entered into force, because by 25.4.2000 only 22 states, and not the required 26 states, had signed the protocol. In recent years there has been a marked evolution towards approaches based on precaution and prevention, with parties agreeing to move from controlled dispersal at sea of a variety of wastes towards integrated land-based solutions. Agenda 21, adopted at the Rio Conference in 1992, encouraged this new orientation (IMO, 1997a).

Two new principles, the precautionary approach and the polluter pays principle were defined in the 1996 Protocol. Preventive measures must be taken when there is reason to believe that waste introduced into the marine environment is likely to cause harm even when there is no conclusive evidence to prove a causal relationship between inputs and their effects. That means for the handling of dredged material in the future, that there will sometimes be more restrictions to disposal than in the past and a strong emphasis on the control of contaminants at the source. Those who are engaged in disposal or incineration at sea bear the cost of meeting the pollution prevention and control requirements for the authorised activities (IMO, 1997b).

The basic rules of the 1996 Protocol are as follows:

- to protect and preserve the marine environment from all sources of pollution;
- to take effective measures, according to scientific, technical and economic capabilities to prevent, reduce and where practicable eliminate marine pollution caused by disposal or incineration at sea;
- applications to disposal shall consider other waste management options, such as re-use, off-site recycling, destruction of hazardous constituents, treatment to reduce or remove the hazardous constituents, disposal on land or into air;
- no disposal allowed except of: dredged material, sewage sludge, fish waste, vessels and platforms or other man-made structures at sea; inert, inorganic geological material; organic material of natural origin and bulky items primarily comprising iron, steel, concrete and similarly unharmful materials for which the concern is physical impact;
- developing an Action List with selected substances which are toxic, persistent and bioaccumulative (e.g. organohalogens, petroleum hydrocarbons, copper, zinc, cyanides, fluorides, pesticides) from anthropogenic sources. Waste which contains more than the defined threshold of these substances are not allowed to be disposed in the sea;
- any disposal need to be permitted and should include precise permit conditions;
- the protection of the marine environment includes complementary regional and national instruments taking account of specific circumstances and the needs of those regions and states;
- at a regional or a national level more stringent measures may be adopted;
- relevant international agreements and actions (United Nations Convention on the Law of the Sea 1982, the Rio Declaration on Environment and Development and Agenda 21) are taken into account (IMO, 1997b).

Specific guidance for the implementation of the London Convention to dredged material has been developed since 1986 and is currently set out in the so-called Dredged Material Assessment Framework (DMAF), last adopted in 1995 and in May 2000 DMAF will be reviewed (IMO, 1997b).

4.2.1.3 The Oslo and Paris Convention (OSPARCON)

The Convention for the Protection of the Marine Environment of the North-East Atlantic, signed 1992 in Paris and entered into force on 25.03.1998, replaced the OSLO Convention of 1972 and the Paris Convention 1974 (Lagoni 1996). Contracting Parties are Belgium, Denmark, the European Community, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland. The European community is not acting as a party because the Member States want to realise their own national politics (Krämer, 1996). Several governmental and non-governmental organisations have an observer status at OSPAR (see appendix 4.2.1.3 a) (OSPAR Commission, 2000a).

The regional OSPAR Convention specifies the North-East Atlantic United Nations Convention on the Law of the Sea 1982, particularly Part XII about the protection and preservation of the marine environment. The Convention is dynamic, i.e. its resolutions and recommendations are continuously developed. It also contains international standards which increasingly influence national jurisdictions, as they are considered as minimum standards. Moreover, they are important parameters in the permitting practise of national administrations and the assessments of environmental impacts (Lagoni, 1996).

The Commission has the task of developing programmes for the reduction or ban of substances which are toxic, persistent and bio-accumulative. The following political principles have to be considered:

- the precautionary principle, i.e. preventive measures have to be implemented when marine pollution is expected to happen;
- the polluter pays principle, i.e. the polluter has to pay the costs for preventive and sanitationary measures (is not in practise);
- action programmes have to be based on the 'best available technology' (point sources) and 'the best environmental practise' (diffuse sources), so that they have to be amended continuously;
- the principle of sustainability (but it is not specified in the Convention) (Lagoni, 1996).

The working structure of the OSPAR Commission, as amended in 2000, is shown in figure 4-1.

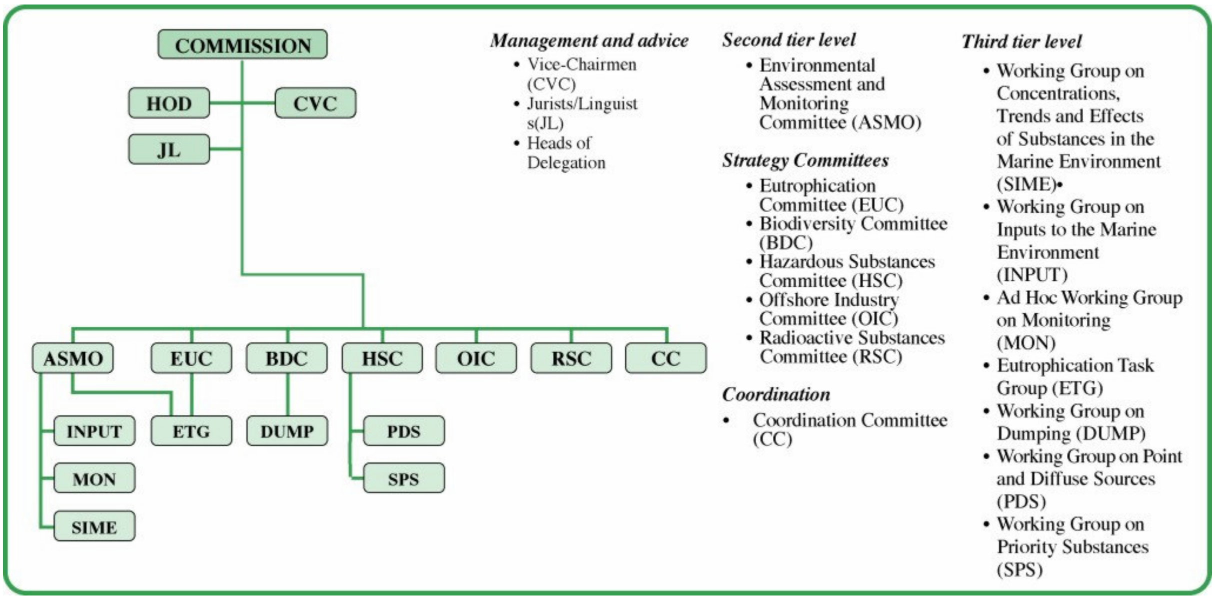


Figure 4-1: Permanent Working Structure of the OSPAR Commission (OSPAR Commission, 2000c)

OSPAR 2000 concluded to retain the ASMO (Environmental Assessment and Monitoring Committee) and in order to promote the implementation of the five OSPAR strategies second tier Committees for each strategy were established (see figure 4-1). On the third tier level several working groups were founded as for example the Working Group on Dumping (DUMP)

(OSPAR Commission, 2000c). OSPAR Commission resolutions are normally passed by consensus, seldom by three quarters majority. Moreover, the Commission controls the implementation of the resolutions by a monitoring system. But, if a contracting party does not meet the resolutions, the Commission is not allowed to sanction it. Indeed, the contracting Parties are obliged to report regularly about their activities to adapt national law, so that the Commission is able to produce political power (Lagoni, 1996).

In contrast to older Conventions, for example the London Convention, no 'black or grey lists' of hazardous substances are defined. The OSPAR Commission enact flexible, but binding standards for the permission process of the national administrations, for example, the discharge from point sources into the sea. The duty to obtain a permit is an obligation under international law which national jurisdiction of the contracting Parties has to comply with (Lagoni, 1996). Hence, the discharge of substances in national waters is no longer of national but international concern. Nevertheless differences in national practises between the contracting Parties still exists, because the OSPAR standards are only minimum values and every Party is allowed to install more severe national standards.

In 1996 the OSPAR Commission adopted an approach of co-operation with other international organisations. Co-operation with other organisations will be channelled via the UNEP Secretariat for the implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). A representative of OSPAR participated as an observer in meetings of the Committee of North Sea Senior Officials (CONSSO). Close co-operation was established with the Secretariat of the Fifth International Conference on the Protection of the North Sea, in particular regarding the development of harmonised reporting systems and procedures for nutrients and hazardous substances.

Contacts with the Helsinki Commission were intensified in order to increase the co-ordination of activities. The Secretariat participated in the third meeting of the 'Inter-Regional Forum' (IRF) organised by the EEA-European Topic Centre on Marine and Coastal Environment (ETC/MC). Priority will be given to establishing a high but realistic level of harmonisation and synchronisation of reporting arrangements and assessment cycles. Contacts were intensified with the EMEP programme (Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe) under the United Nations Economic Commission for Europe (UN-ECE) with a view to mutually improving the work on airborne contaminants, especially in the field of emissions and the evaluation of transport and disposal into sea areas. The International Council for the Exploration of the Sea (ICES) plays a major role in advising the OSPAR Commission on its assessment and monitoring work (OSPAR Commission, 2000a).

In the 1998 Ministerial Meeting of the Commission in Sintra the contracting parties of OSPAR agreed to work towards ending discharges, emissions and losses of hazardous substances to the marine environment by 31.12.2020, and to establish a zero emissions target (OSPAR Commission, 1998).

Parts of the Implementation of the OSPAR Action Plan 1998 – 2003

In 1998 and 1999 the Commission adopted strategies to direct its future work in the following five main areas:

- protection and conservation of ecosystems and biological diversity;
- hazardous substances;
- radioactive substances;
- eutrophication;
- environmental goals and management mechanisms for offshore activities (OSPARCOM, 2000d).

Work to develop criteria for the species and habitats that require priority protection continued on the basis of the outcome of the workshop held in Texel in 1997 which had resulted in the so-called 'Texel criteria' (see appendix 4.2.1.3 b). A further workshop was held in July 1999. A report on the 'Impact of marine sand and gravel extraction' was finalised as a contribution to the information available for drafting the Quality Status Reports. Work on the impact of dredging will start in the 1999/2000 intersessional period (OSPARCOM, 1999a).

Hazardous substances are treated by the ad hoc Working Group on the development of a dynamic selection and prioritisation mechanism for hazardous substances (DYNAMEC) (OSPAR Commission, 2000). In accordance with the requirements set out in OSPAR's Strategy with regard to hazardous substances, the development of a dynamic selection and prioritisation mechanism for hazardous substances was initiated and considerable progress has been made. This mechanism will consist of procedures for initial selection, ranking and the selection of substances for priority action. Furthermore, a methodology will be developed for the assessment of risks in the marine environment. In the 1998/1999 intersessional period, outlines for procedures were developed for all these elements (OSPARCOM 1999a). OSPAR 2000 has adopted the outcome of the first application of the dynamic selection and agreed upon a list of 'Chemicals of Priority Action' (see appendix 4.2.1.3 c). In future the Commission will:

- further elaborate the DYNAMEC mechanism;
- develop programmes and measures for the substances of the 'Priority List';
- work on the substitution of hazardous substances;
- develop programmes and measures to combat pollution (OSPARCOM, 2000d).

As a basis to combat pollution lead countries are asked to prepare background documents in order to identify the sources of the 'Chemicals of Priority Action', their pathways through the marine environment, as well as descriptions of 'Best Available Techniques' (BAT) or 'Best Environmental Practices' (BEP) to reduce discharges, emissions and losses of these substances have to be carried out (compare to appendix 4.2.1.3 c) (OSPARCOM, 2000d):

> 4 polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) short-chained chlorinated paraffines (SCCPs), polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hexachlorocyclohexane isomers (HCHs), lead and organic lead compounds, mercury and organic mercury compounds, organic tin compounds, nonylphenol/ethoxylates (NP/NPEs) and related substances, musk xylene,

brominated flame retardants, pentachlorophenol (PCP), certain phthalates – dibuthylphthalate and diethylhexylphthalate, octylphenol, HMDS, endosulfan.

Moreover measures to reduce anthropogenic loads in dredged material to be deposited at sea have to be carried out (OSPARCOM 2000d).

Programmes of work have been established for (parts of them) (see appendices 4.2.1.3 f and 4.2.1.3 g):

- major sources and occurrence of medium and long chained chlorinated paraffins;
- mercury pollution from the chlor-alkali industry;
- BAT Reference Documents (BREF) concerning the primary and secondary iron and steel industry, the pulp and the paper industry;
- BAT for industrial sectors discharging complex effluents;
- the preparation of draft reports on environmental effects of dredging techniques of contaminated sediments and on the estimation of actual contaminant inputs from dredged material (OSPARCOM, 1999a).

The long-term use of the reported data are facilitated. Pollution reports are published and pilot studies about PAHs and mineral oil inputs to the maritime area are set up. OSPAR adopted a Co-ordinated Environmental Monitoring Programme (CEMP) and works on an overview of research activities/progress on endocrine disrupting chemicals OSPARCOM, 1999a).

The collection of qualitative and quantitative data of environmental problems due to hazardous substances will be continued. Monitoring data of these substances and their effects in the maritime area will be developed (OSPARCOM, 2000d). Guidelines are finalised concerning:

- sediment monitoring of tributyl tin, biota monitoring of PAH, PCB in suspended particulate matter (OSPARCOM, 1999a).

The Commission will work on the development and use of tools, such as background or reference values, ecotoxicological assessment criteria, statistical techniques and mathematical models to assess inputs to the maritime area and their effects on the environmental condition of the sea. Furthermore a constructive dialogue on the reduction of hazardous substances should be established with all parties concerned, including, producers, user groups, authorities and environmental NGOs (OSPARCOM, 2000d).

4.2.1.4 Helsinki Convention (HELCON)

The first Convention on the Protection of the Marine Environment of the Baltic Sea Area was signed in 1974 by the coastal states of the Baltic Sea at that time. In 1992, a new Convention was signed by all the countries bordering on the Baltic Sea and by the European Economic Community. The new 1992 Convention entered into force on 17 January 2000 thus replacing the 1974 Convention. The governing body of the Convention is the Helsinki Commission - Baltic Marine Environment Protection Commission - also known as HELCOM. The present contracting parties to HELCOM are Denmark, Estonia, European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden (HELCON, 2000).

The Helsinki Convention of 1974, issued to protect the marine environment of the Baltic Sea, was the first international agreement to cover all sources of pollution, both from land and from ships as well as airborne. To accomplish its aim, the Convention calls for action to curb various sources of pollution. The 1992 Convention overtook these aims and added some as follows:

- sea protection from pollutants from offshore industries;
- protection of nature and biodiversity (Ehlers, 1996).

Decisions taken by the Helsinki Commission are regarded as recommendations to the governments concerned. These HELCON Recommendations are to be incorporated into the national legislation of the member countries. The commission consists of four committees and a programme implementation task force. Several governments and organisations have an observer status (see appendix 4.2.1.4).

The 1992 Convention fulfils the requirements of the United Nations Convention on the Law of the Sea. Although the 1992 Convention included in its actions the catchment areas, it is still not concerned with the management of river sediments. Therefore a source of marine pollution is neglected. Ehlers (1996) concludes that the protection of the Baltic Sea from land sources is still too weak and not specific enough.

4.2.1.5 The International Conferences on the Protection of the North Sea (ICPNS)

The First International Conference on the Protection of the North Sea was held in 1984 with participation from Belgium, Denmark, France, Germany, the Netherlands, Norway, Sweden, United Kingdom and the European Commission. The aim was to provide political impetus for the intensification of the work within relevant international bodies, and to ensure more efficient implementation of the existing international rules related to the marine environment in all North Sea States. It was thought that a political declaration from a North Sea perspective, would stimulate and bring further ongoing work within the existing international conventions, e.g. the OSPAR Convention 1992.

At the London Conference, non-governmental organisations were for the first time permitted to attend parts of the conference. At the Hague Conference in 1990 the Swiss Confederation for the first time attended. The decisions of Ministers at the North Sea Conferences, as recorded in the Ministerial Declarations, are political commitments, which have played an important role in influencing legally binding environmental management decisions both nationally and within the framework of competent international bodies (ICPNS, 2000).

The International Conference on the Protection of the North Sea 1984

In the Bremen Declaration the Ministers underlined to improve the protection of the North Sea, focusing on five main areas:

- reduction of inputs from rivers and coastal waters to the North Sea by establishing further internationally binding measures;
- reduction of atmospheric pollution through the Paris Convention;
- reduction of pollution from ships, off-shore platforms and waste disposal at sea;
- improvement of joint monitoring and assessment of the North Sea environment.

The International Conference on the Protection of the North Sea 1987

One of the most important political decisions at the London Conference was the acceptance that the basis of their action in regard to the reduction of inputs of substances that are persistent, toxic and liable to bioaccumulate should be based on 'the principle of precautionary action'. Such inputs should be limited "*by the use of the best available technology and other appropriate measures*". Other elements of the declaration were (ICPNS, 2000):

- a substantial reduction (50 %) between 1985 and 1995 in total inputs to the North Sea via rivers and estuaries of substances that are persistent, toxic and liable to bioaccumulate;
- a substantial reduction (50 %) between 1985 and 1995 in inputs of phosphorus and nitrogen;
- to reduce atmospheric emissions of pollutants, based upon best available technology, within 4 years;
- to phase out the disposal of industrial wastes in the North Sea by 31.12.1989.

The International Conference on the Protection of the North Sea 1990

- a list of 36 hazardous substances was identified in respect of the 50 % reduction target and a 70 % reduction target was established for the most dangerous substances to the environment;
- further concrete steps were taken to alleviate eutrophication;
- the termination date for marine incineration was brought forward to 31.12.1991;
- to phase out and destroy PCBs and hazardous PCB-substitutes.

The Intermediate Ministerial Meeting 1993

- the need for measures to make significant reductions of anthropogenic inputs of polycyclic aromatic hydrocarbons (PAHs) between 1985 and 2000 from all sources of concern to the marine environment (ICPNS, 2000) was confirmed;
- the meeting members agreed to work on the adoption of international rules as soon as possible concerning liability and compensation for damage caused by accidents involving ships carrying cargoes of hazardous and noxious substances;
- the acknowledgement that, to reach the 50 % reduction target for phosphorus and nitrogen not be achieved.

The International Conference on the Protection of the North Sea 1995

The Ministerial Declaration addresses a wide range of issues as regards the protection of the North Sea such as species and habitats issues, pollution by hazardous substances and nutrients, radioactive substances and pollution from ships and offshore installations. Due to the concern about the impact of fisheries on the commercially important fish stocks, on other fish stocks and on the marine ecosystem in general, the fishery activities were introduced as a new issue.

The North Sea Conferences have played an important role in influencing environmental management decisions on a much wider level. An integrated approach to pollution control has gradually been developed in order to ensure that all aspects of processing and waste management are addressed in a holistic manner rather than focusing on a single emission pathway. Moreover, the conferences have provided the vehicle for political co-operation: targets have been set and decisions have been reached unanimously. The 5th North Sea Conference will take place in Bergen, Norway in March 2002 (ICPNS, 2000).

4.2.1.6 The International Council for the Exploration of the Sea (ICES)

The International Council for the Exploration of the Sea (ICES) is the oldest intergovernmental organisation in the world concerned with marine and fisheries science. Since its establishment in Copenhagen in 1902, ICES has been a leading scientific forum for the exchange of information and ideas on the sea and its living resources, and for the promotion and co-ordination of marine research by scientists within its member countries.

ICES currently operates under the terms of its 1964 Convention. The membership has increased from the original eight countries in 1902 to currently 19 countries: Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, the Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, United Kingdom and the United States. Each year, ICES holds more than 100 meetings of its various working groups, study groups, workshops, committees and an annual Science Conference (ICES, 2000).

Since the 1970s, a major area of ICES work as an intergovernmental marine science organisation is to provide information and advice to member country governments and international regulatory commissions (including the European Commission) for the protection of the marine environment and for fisheries conservation. This advice is peer-reviewed by the Advisory Committee on Fishery Management (ACFM), that is responsible for scientific information and advice on living resources, such as fish, and their harvesting. The second reviewer before passing on, is the Advisory Committee on the Marine Environment (ACME), that works on the provision of scientific advice and information on the marine environment, including marine pollution.

Oceanographic investigations form integral parts of the ICES programme of multi-disciplinary work aimed at understanding the features and dynamics of water masses and their ecological processes. In many instances emphasis is placed on the influence of changes in hydrography and current flow on the distribution, abundance, and population dynamics of finfish and shellfish stocks. These investigations are also relevant to marine pollution studies because physical oceanographic conditions affect the distribution and transport of contaminants in the marine environment (ICES, 2000).

Due to its status as an scientific consultant for the governments of the member states and its observer status in several international conventions, such as OSPAR, ICES is able to influence marine protection policies including those which are concerned with the management of dredged material.

4.2.1.7 The Permanent International Navigation Association (PIANC)

The Permanent International Navigation Association (PIANC) is a world-wide organisation, founded in 1885 in Belgium, that is concerned with maritime ports and inland waterways. The association promotes contact and advances and disseminates technical, economic, and environmental information in order to efficiently manage, develop, sustain, and enhance inland, coastal and ocean waterways, ports and their infrastructure, in a changing environment (PIANC 2000).

General membership is composed of individuals, port authorities, universities, Federal and State agencies, and private companies. Forty nations belong to PIANC, including Canada, the United Kingdom, Japan, Russia, China, and most of the European nations. Members have an opportunity to serve on a technical working group, submit papers for publication in the International Bulletin, or participate in national or international PIANC conferences.

The Permanent International Commission operates through a Council, which directs the working level permanent technical committees, international study commissions, and working groups. Technical working groups are composed of participants from member countries. The groups gather, analyse, and consolidate state-of-the-art material from each country. Working group reports and a quarterly 'International Bulletin' are sent to each member.

Every four years an International Congress, open to all members, is held for the presentation and discussion of papers on subjects pertaining to waterways and maritime navigation. PIANC also participates in technical activities with other organisations to study navigation problems and joins with them to present symposia on related subjects (PIANC, 2000).

4.2.1.8 Central Dredging Association (CEDA)

The Central Dredging Association (CEDA) is a member of the World Organisation of Dredging Associations (WODA). CEDA is an independent, non-profit, non-governmental and professional society. It aims to provide a forum for all those involved with any kind of activity related to dredging and who live or work in Europe, Africa or the Middle-East. It is financed by member subscriptions. The objectives of CEDA are as follows:

- to promote the education and instruction of its members and others in those fields concerned with dredging and dredging related activities;
- to generate and disseminate quality information on dredging and associated matters;
- to develop or contribute to the development of guidelines and standards relating to good practice;
- to initiate and/or support research relevant to dredging activities;
- to be pro-active in relevant policy making;
- to enhance the public understanding of dredging and recognition of its contribution to society (CEDA, 2000).

The association organises congresses, seminars, courses and publishes reports, proceedings and guidance notes. It participates in training in developing countries. It acts as an official observer at the London Convention 1972 and the OSPAR Convention 1992 and co-operates with several international organisations, such as the International Navigation Association (PIANC), the International Maritime Organisation (IMO), the International Association of Dredging Companies (IADC) and the International Association of Ports and Harbours (IAPH). Members of CEDA are from many fields and include:

- designers, builders and suppliers of dredging vessels and ancillary equipment;
- dredging contractors;

- port, maritime and navigational authorities, government departments and public works;
- research and educational institutes;
- towage companies, media, insurers.

In areas where the number of members makes this feasible, National or Regional Sections of CEDA have been established, that regularly organise technical evening programmes or site visits (CEDA, 2000).

With regard to dredged material CEDA regards it as a resource and not as waste as in some European states. Moreover CEDA demands for more harmonisation between the legislation controlling marine, estuarial and riverine dredged material disposal. Then it would be easier to find an optimal solution for the handling of dredged material considering economic as well as environmental factors (Burt, 2000).

4.2.1.9 International Association of Ports and Harbors (IAPH)

The International Association of Ports and Harbors (IAPH), founded in 1955, is a worldwide non-profit organisation mainly of public port authorities and agencies. In addition to 230 regular members about 100 manufactures and providers of port products or services are associated. IAPH aims at sustaining co-operation and information exchange among the international port and maritime industries. As a NGO it has a consultative status in international trade and transportation organisations, such as IMO, UNCTAD, UNEP, to ensure that the interests of port industries are represented in current or future regulations (see Chapter 4.2.1.1). For example in the IAPH/IMO Interface Group the association tries to strengthen the claims of the port industries in all IMO port-related discussions (chaired by P. Struijs (Port of Rotterdam), 2nd Vice-President of IAPH).

Three internal committees (finance, constitution/by-laws, long range planing/review) and twelve technical committees are established to work on issues of interest and concern to all IAPH members. Dredging Task Force (DTF), one of the technical committees, gives advice how to optimise the management of dredged material considering the requirements of international dredging regulations. DTF analyses legal and policy issues and evaluates the long-term dredged material disposal problems of the ports in order to support the lobbying of IAPH within the London Convention (see Chapter 4.2.1.2). Moreover it co-ordinates the communication with other international organisations concerned with dredged material, such as PIANC or IADC (International Association of Dredging Companies) (see chapter 4.2.11.7) (IAPH, 2000).

4.2.1.10 Non-governmental organisations (NGOs)

Although many international, national and local non-government organisations (NGOs) exist, which aim to protect the Planet Earth the following concentrates on the two most well known.

The WWF-World Wide Fund For Nature (WWF) was set up in 1961. With 24 national organisations, 5 associates, and 26 programme offices, WWF claims to have played a major role in the evolution of the international conservation movement. While in the 1960s WWF was mainly engaged in wildlife conservation, forest conservation has been an important focus since the 1970s. Due to the marine campaign 'The Seas Must Live' in 1976, marine sanctuaries for whales, dolphins, and seals, and the protection of marine turtle nesting sites were founded. In the 1980s WWF realised the need to integrate development with conservation supporting the idea of debt-for-nature swaps. Today the aims are classified into three interdependent categories (WWF, International 2000):

- the preservation of biological diversity;
- promoting the concept of sustainable use of resources;
- reducing wasteful consumption and pollution.

The activities are focused on three key areas: forests, freshwater ecosystems, and oceans and coasts. The current major campaigns are:

- Living Planet,
- Climate Change,
- Endangered Seas (this campaign aims to safeguard fisheries and marine biological diversity; to reduce government subsidies that contribute to overfishing; and to promote market incentives for sustainable fishing),
- Living Waters (an integration of conservation with human needs should to be achieved; in catchment areas sustainable approaches to water management which balance long-term human uses and biodiversity conservation are to be developed (WWF, International 2000)).

The Dutch division of the WWF for example, has launched several projects along the Rivers Meuse and Rhine and in the Dutch coastal region, in which room is created for natural processes, such as river and tidal dynamics and grazing by large herbivores (Litjes, 2000).

The WWF co-operates with governments, other international and national non-governmental organisations and local communities. It has an observer status in several international conventions and organisations to protect the fluvial and marine environment, such as for example OSPAR or ICPR (see chapter 4.2.1 and 4.3, appendices 4.2.1.3a and 4.2.1.4). Moreover it may act as a consultant to establish the river basin management plans of the EU-WFD (see chapter 4.1).

Regarding TBT the WWF demands a ban by at least in 2003 through IMO and the EU. In addition all other toxic ship paints should be prohibited (see Chapter 4.2.3.4) (WWF Germany, 2000).

Greenpeace, an independent NGO, started its first campaign to object against US-American nuclear tests in 1971. Today Greenpeace has national offices in 32 countries all over the world. The organisation’s guidelines are determined by the 'Council of Greenpeace International' which consists of trustees of the national offices. Greenpeace concentrates on the following topics:

Nuclear tests, nuclear/renewable energy, climate change, biodiversity of terrestrial and marine ecosystems, genetic engineering and chemicals (Greenpeace International, 2000).

The campaigns are based on the principle of pacifism. Due to spectacular activities Greenpeace became well known. It tried to sensitise the population to the environmental damage caused by for example nuclear tests, atomic waste, extinction of species, production of toxic chemicals, pollution of seas or the rise of atmospheric CO_2-concentrations. Moreover Greenpeace developed new techniques to reduce the pollution of the planet, such as the utilisation of solar energy and refrigerators without chlorofluorocarbons. In 1996 Greenpeace presented not only principles for ecological fisheries but also for sustainable forestry (Greenpeace Germany, 2000).

A good co-operation with the media is one of the reasons for the success of Greenpeace. In addition, lobbying is quite important to be able to influence future environmental politics and international conventions. Greenpeace also has an observer status in various international conferences, as for example in ICPNS, in UNEP, FAO, OSPAR or ICPR (see chapter 4.2 and 4.3, appendices 4.2.1.3a and 4.2.1.4). Moreover NGOs are asked to consult the development of the river basin management plans of the EU-WFD (see chapter 4.1).

Concerning the relocation of dredged material at sea, Greenpeace Netherlands criticises the fact that only very few chemicals are analysed and that combination toxicity is not taken into account. The long-term objective is to ban the production of hazardous substances. They also state that further pollution of the environment by dredged material should be avoided. Therefore known toxic chemicals, like TBT, should be added to the priority list of hazardous substances and bio-assays should be implemented. All dredged material should be put in special depots or separated in a toxic and non-toxic fraction, where the latter should be allowed to be relocated in the North Sea (Matser/Beekman, 2000).

4.2.2 International regulations concerning water and sediment quality (immission approach)

This chapter deals with the environmental quality (immission) approach in international agreements, declarations and regulations concerning North Sea water and sediment quality.

At the 4th International Conference of the Protection of the North Sea (ICPNS) (1995) the so called Esbjerg Declaration was adopted. Concerning the prevention of pollution by hazardous substances (§§17-29, Annex 2) the following is stated:

"*The Ministers AGREE that the objective is to ensure a sustainable, sound and healthy North Sea ecosystem. The guiding principle for achieving this objective is the precautionary principle. This implies the prevention of the pollution of the North Sea by continuously reducing discharges, emissions and losses of hazardous substances thereby moving towards the target of their cessation within one generation (25 years) with the ultimate aim of concentrations in the environment near background values for naturally occurring substances and close to zero concentrations for man-made synthetic substances. The Ministers AGREE that in this work scientific assessment of risks is a tool in setting priorities and developing action programmes*."

In the context of the Esbjerg Declaration, hazardous substances are defined as substances or groups of substances that are toxic, persistent and liable to bioaccumulate. In this definition toxicity should be taken to include chronic effects such as carcinogenicity, mutagenicity and teratogenicity and adverse effects on the function of the endocrine system (Annex 2, ICPNS, 1995).

The Esbjerg Declaration on hazardous substances was confirmed by the Sintra Statement adopted by the Ministerial Meeting of the OSPAR Commission (1998a). There the following is stated:

"*WE AGREE to prevent pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous substances (that is, substances which are toxic, persistent* *and liable to bioaccumulate or which give rise to an equivalent level of concern), with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. WE SHALL MAKE every endeavour to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020. WE EMPHASISE the importance of the precautionary principle in this work*."

Further the OSPAR Commission will implement its strategy "*progressively and with well-defined intermediate targets; this implementation will start from the OSPAR List of Chemicals for Priority Action which we have already agreed, including carrying forward the drawing up of programmes and measures by 2003 for the control of discharges, emissions and losses of the substances on that list, and their substitution with less hazardous or non-hazardous substances where feasible; develop a dynamic selection and prioritisation mechanism, in order to tackle first the substances and groups of substances which cause most concern, and use it to up-date by 2000 the current OSPAR List of Chemicals for Priority Action; identify and assess substances that, although not fulfilling all the traditional criteria of a hazardous substance give rise to equivalent concern, especially those that act as endocrine disruptors; develop the necessary programmes and measures within three years after agreeing on the need for OSPAR action on a substance or group of substances*".

The proclaimed reduction aims give rise to the question what the background values for naturally occurring substances are. In the framework of the OSPAR Working Group on Concentrations, Trends and Effects of Substances in the Marine Environment (SIME) an OSPAR/ ICES Workshop on the overall evaluation and update of background/ reference concentrations for nutrients and for contaminants in sea water, biota and sediments (SIME, 1997) took place. The report of that workshop might serve as an reference for background concentrations.

Further Sediment Quality Criteria (SQC) are fixed on nation level, because of regional differences in natural backgrounds and local ecosystems and the functional use of the involved ecosystem. An overview of SQC of the North Sea riparian states is given by Lauwaert (1998). The Dutch and German SQC have been examined in previous chapters.

4.2.3 International regulations concerning emission control

In this chapter the mechanism and instruments for the source (emission) control in the international declarations and regulations with regard to the North Sea are examined. Firstly, the general principles and standards are described, secondly the chapter focuses on the reduction of discharges concerning hazardous substances. Thirdly a short note is given on emission control mechanisms with respect to dredged material and last a brief overview over the regulations with regard to tributyl tin (TBT) by different Conventions is given.

4.2.3.1 General principles of emission control by OSPARCON

According to the OSPARCON (1992) the Contracting Parties shall take all possible steps to prevent and eliminate pollution and shall take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected. To this end the Contracting Parties shall, individually and jointly, adopt programmes and measures and shall harmonise their policies and strategies (Art. 2).

The Contracting Parties shall apply two basic principles:

a. the <u>precautionary principle</u>, by virtue of which preventive measures are to be taken when there are reasonable grounds for concern that substances or energy introduced, directly or indirectly, into the marine environment may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects;

b. the <u>polluter pays principle</u>, by virtue of which the costs of pollution prevention, control and reduction measures are to be borne by the polluter.

Further Art. 2 of the OSPAR Convention states: In implementing the convention, contracting parties shall adopt programmes and measures which contain, where appropriate, time-limits for their completion and which take full account of the use of the latest technological developments and practices designed to prevent and eliminate pollution fully.

To this end they shall:

i. taking into account the criteria set forth in Appendix 1 (see below), define with respect to programmes and measures the application of, *inter alia*,
   - best available techniques (for point sources (Annex I Art. 1)
   - best environmental practice (for diffuse sources (Annex I Art. 1)
   - including, where appropriate, clean technology;

ii. in carrying out such programmes and measures, ensure the application of best available techniques and best environmental practice as so defined, including, where appropriate, clean technology.

The Contracting Parties shall apply the measures they adopt in such a way as to prevent an increase in pollution of the sea outside the maritime area or in other parts of the environment.

No provision of the Convention shall be interpreted so as to prevent the Contracting Parties from taking, individually or jointly, more stringent measures with respect to the prevention and elimination of pollution of the maritime area or with respect to the protection of the maritime area against the adverse effects of human activities.

Consequently the 'Best Available Techniques' (BAT) and the 'Best Environmental Practice' (BEP) are also required for the pollution from land-based sources (Art. 3).

Therefore it is necessary to look in more detail at how BAT and BEP are defined (Appendix I).

<u>Best Available Techniques (BAT)</u>

1. The use of the best available techniques shall emphasise the use of non-waste technology, if available.

2. The term 'best available techniques' means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the

best available techniques in general or in individual cases, special consideration shall be given to:

a. comparable processes, facilities or methods of operation which have recently been successfully tried out;
b. technological advances and changes in scientific knowledge and understanding;
c. the economic feasibility of such techniques;
d. time limits for installation in both new and existing plants;
e. the nature and volume of the discharges and emissions concerned.

3. It therefore follows that what is 'best available techniques' for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.
4. If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be applied.
5. 'Techniques' include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.

Best Environmental Practice (BEP)

1. The term 'Best Environmental Practice' means the application of the most appropriate combination of environmental control measures and strategies. In making a selection for individual cases, at least the following graduated range of measures should be considered:
   a. the provision of information and education to the public and to users about the environmental consequences of choice of particular activities and choice of products, their use and ultimate disposal;
   b. the development and application of codes of good environmental practice which covers all aspect of the activity in the product's life;
   c. the mandatory application of labels informing users of environmental risks related to a product, its use and ultimate disposal;
   d. saving resources, including energy;
   e. making collection and disposal systems available to the public;
   f. avoiding the use of hazardous substances or products and the generation of hazardous waste;
   g. recycling, recovery and re-use;
   h. the application of economic instruments to activities, products or groups of products;
   i. establishing a system of licensing, involving a range of restrictions or a ban.
2. In determining what combination of measures constitute best environmental practice, in general or individual cases, particular consideration should be given to:
   a. the environmental hazard of the product and its production, use and ultimate disposal;
   b. the substitution by less polluting activities or substances;

   c. the scale of use;
   d. the potential environmental benefit or penalty of substitute materials or activities;
   e. advances and changes in scientific knowledge and understanding;
   f. time limits for implementation;
   g. social and economic implications.

3. It therefore follows that best environmental practice for a particular source will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.
4. If the reduction of inputs resulting from the use of best environmental practice does not lead to environmentally acceptable results, additional measures have to be applied and best environmental practice redefined.

Concerning point sources the Convention states further: Point source discharges to the maritime area, and releases into water or air which reach and may affect the maritime area, shall be strictly subject to authorisation or regulation by the competent authorities of the Contracting Parties. Such authorisation or regulation shall, in particular, implement relevant decisions of the Commission which bind the relevant Contracting Party. The Contracting Parties shall provide for a system of regular monitoring and inspection by their competent authorities to assess compliance with authorisations and regulations of releases into water or air (Annex 1. Art. 2).

4.2.3.2 Emission control with regard to hazardous substances

According to the Sintra (and Esbjerg) Declaration (see chapter 4.2.2) a special strategy with regard to hazardous substances is necessary to reach the proclaimed reduction goal. The OSPAR Strategy with regard to Hazardous Substances (OSPARCOM, 1998c) uses the principles stated in Art. 2 of the Convention (see above) and in addition the principle of substitution, i.e. the substitution of hazardous substances by less hazardous substances or preferably non-hazardous substances where such alternatives are available, which is also included by the application of the BEP. Another guiding principle is: emissions, discharges and losses of new hazardous substances shall be avoided, except where the use of these substances is justified by the application of the principle of substitution.

In this strategy hazardous substances are defined as substances, which fall into one of the following categories (Annex 1):

(i) substances or groups of substances that are toxic, persistent and liable to bioaccumulate (also called PTB criteria);

(ii) other substances or groups of substances which are assessed by the Commission as requiring a similar approach as substances referred to in (i), even if they do not meet all the criteria for toxicity, persistence and bioaccumulation, but which give rise to an equivalent level of concern.

    This category will include both substances which work synergistically with other substances to generate such concern, and also substances which do not themselves justify inclusion but which degrade or transform into substances referred to in (i) or substances which require a similar approach.

The Commission will identify and assess such other substances or groups of substances using available information and internationally accepted methods and criteria.

Further definitions of the criteria toxicity, persistent and bioaccumulation are given in Annex 5.

The strategy is to be implemented through the Action Plan (OSPARCOM, 1999a). This document lists different activities concerning hazardous substances as follows:

1. Selection and prioritisation of hazardous substances;
2. Substitution of hazardous substances;
3. Development of programmes and measures to combat pollution;
4. Monitoring;
5. Assessment.

Ad 1. Selection and prioritisation of hazardous substances

In accordance with the requirements set out in OSPAR's Strategy with regard to Hazardous Substances, the development of a dynamic selection and prioritisation mechanism for hazardous substances was initiated and considerable progress has been made. This mechanism will consist of procedures for: initial selection, ranking and selection of substances for priority action (OSPARCOM, 1999b) (compare chapter E 3.2).

There are two different lists of selected and prioritised substances:

- the 1998 OSPAR List of Candidate Substances at Annex 3 to the Strategy with regard to Hazardous Substances (includes 246 substances or groups of substances) and
- the OSPAR List of Chemicals for Priority Action at Annex 2 (includes 15 substances) both of the Strategy (OSPARCOM 1998 c) and the Action Plan (OSPARCOM, 1999a).

The Ad-Hoc Working Group on the 'Development of a Dynamic Selection and Prioritisation Mechanism for Hazardous Substances' (DYNAMEC) uses a dynamic selection and prioritisation mechanism to update the OSPAR 'List of Chemicals for Priority Action' by 2000 (OSPAR, 1999b), but this process has not been completed (WIANDT, S., UBA note 17.5.00). At present, the ranking done by DYNAMEC results in 4 lists (OSPAR (PRAM) 2000):

a. a ranking list for water based on measured environmental concentration and the properties of the substances;
b. a ranking list for water based on modelled exposure scores (based on calculation from production volumes and use patterns);
c. a ranking list for sediments based on measured environmental concentration and the properties of the substances; and
d. a ranking list for sediments based on modelled exposure scores (based on calculation from production volume and use pattern).

To facilitate the discussions at OSPAR 2000, a 'selection box' of 80 substances was extracted by DYNAMEC in a pragmatic way by

(i) combining a selection of the 48 top-ranked substances from each of the 4 ranked lists,

(ii) excluding from this selection substances already on Annex 2 of the strategy and

(iii) adding all those initially selected substances which fulfilled the selection criteria I (most severe PTB criteria) or which were flagged as endocrine disruptors.

Further DYNAMEC experts examined the 80 substances on the basis of further elaborated fact sheets and established the basis for a pragmatic grouping of these substances as follows:

Group	Description
I	Substances of very high concern (i.e. POP-like substances or substances with PTB profile, selection I) and indication of production, use or occurrence in the environment
II	Other initially selected substances (with less severe PTB profile) and indication of use or exposure
III	Substances of very high concern (i.e. POP-like substances or substances with PTB profile, selection I) with no indication of use or exposure
IV	Other initially selected substances with no indication of use or exposure
V	Substances with PTB properties but which are heavily regulated or withdrawn from the market
VI	Endocrine disrupters, which do not meet P or B criteria or natural hormones
	Substances which do not meet the initial selection criteria (and which should be deleted from the draft preliminary list of substances of possible concern) or substances already on Annex 2 of the strategy

DYNAMEC recommends that when revising the OSPAR List of Chemicals for Priority Action, OSPAR 2000 might consider in the first instance the 12 substances in groups I and II (listed in Appendix 3 of OSPAR (PRAM) (2000).

To summarise, there are at present 27 priority substances, 15 substances of the current OSPAR List of Chemicals for Priority Action (Annex 2; OSPAR, 1998c) and in addition 12 substances recommended by DYNAMEC for the revision of this list. These substances are listed in the Policy Annex of the report.

Ad. 2. Substitution of hazardous substances;

The substitution of hazardous substances (used on land or on offshore installations) by less hazardous, or preferably non-hazardous substances, has been discussed by various OSPAR subsidiary bodies in the 1998/1999 intersessional period. Proposals for the development of criteria and methods for the identification and use of less hazardous, or preferably non-hazardous substitutes, will be considered further during the 1999/2000 intersessional period (OSPARCOM, 1999b).

Ad.3. Development of programmes and measures to combat pollution;

According to the Action Plan (OSPARCOM, 1999a) the Commission has the duty to :

a. prepare background documents, including descriptions of 'Best Available Techniques' (BAT) and/or 'Best Environmental Practices' (BEP), as a basis for the development of programmes and measures for:

   (i) the substances and groups of substances listed in the attached Annex 2 of the Action Plan (see Policy Annex of the report);

   (ii) the sectors listed in the attached Annex 3 of the Action Plan (see Policy Annex of the report);

b. adopt appropriate programmes and measures (including BAT/BEP) for these sectors, sources and substances with a view to continuously reducing discharges, emissions and losses of hazardous substances;

c. give special attention to:

(i) the development and adoption of programmes and measures for reducing uses of the substances and/or the generation of hazardous substances on the OSPAR list of chemicals for priority action;

(ii) to the need of developing other programmes of work (e.g. as regards diffuse sources of hazardous substances);

d. review OSPAR BAT/BEP Recommendations and other agreements in accordance with the time schedule agreed upon at OSPAR/MMC (1998).

OSPARCOM has carried out several activities and is still in preparation to fulfil these requirements (for more detail see OSPARCOM, 1999b).

Ad. 4. Monitoring

According to the Action Plan the following is required concerning monitoring: In accordance with the Commission's Joint Assessment and Monitoring Programme (JAMP) and taking into account work in other forums, the Commission will continue to collect qualitative and quantitative data and information to identify environmental problems with regard to hazardous substances and to this end:

a. establish inputs of hazardous substances to the marine environment for:

(i) atmospheric inputs, including an inventory of emissions to air and the monitoring of atmospheric pollutants;

(ii) riverine inputs and land-based discharges directly into the marine environment differentiating, where possible, anthropogenic inputs;

(iii) discharges and emissions from particular sectors (including offshore installations) or activities (including the disposal of materials);

(iv) inputs of selected substances (e.g. via pilot studies to establish a detailed overview)

b. monitor hazardous substances in relevant compartments of the marine environment (Co-ordinated Environmental Monitoring Programme) and, in particular:

(i) develop and implement programmes and models to provide suitable monitoring data (e.g. surveys) concerning hazardous substances and their effects in the maritime area[2];

(ii) develop and apply screening methods for hazardous substances not normally monitored particularly those prioritised by the Dynamic Selection and Prioritisation Mechanism for Hazardous Substances (DYNAMEC);

(iii) give priority to the development of suitable monitoring and testing techniques for endocrine disruptors;

(iv) conduct, on the basis of an inter-comparison exercise, a concerted survey of the maritime area to gauge the spatial extent of any adverse effects arising from exposure to endocrine disruptors.

OSPARCOM has started several monitoring programmes, research projects and published several reports about discharges and emissions from particular sectors (see OSPARCOM, 1999b).

<u>Ad. 5. Assessment</u>

By establishing DYNAMEC OSPAR followed its Action Plan to continue the assessment whether there are reasonable grounds for concern with regard to specific hazardous substances (in particular when there is a lack of relevant risk assessment or monitoring data), and initiates immediate programmes to help characterise the risks connected to such substances (OSPARCOM, 1999b).

4.2.3.3 Emission control with respect to dredged material

As mentioned before in this chapter, OSPAR considers in the DYNAMEC lists 3 and 4 hazardous substances for sediment based on either measured environmental concentrations and the properties of the substances or on modelled exposure scores (OSPAR (PRAM) 2000). In the Strategy against Hazardous Substances it is pointed out that the management of dredged materials containing hazardous substances requires special consideration because of the existing occurrence of such substances in sediments and the problem of their removal. Such management is regulated by the OSPAR Guidelines on the Management of Dredged Materials (OSPARCOM, 1998b), and any programmes or measures adopted under Annex II of the OSPAR Convention.

4.2.3.4 Emission control of tributyltin (TBT)

Antifouling paints are used to coat the bottoms of ships to prevent marine organisms such as algae and molluscs attaching themselves to the hull - thereby slowing down the ship and increasing fuel consumption. In the early days of sailing ships, lime and later arsenic was used to coat ships' hulls, until the modern chemicals industry developed effective antifouling paints using metallic compounds.

The compounds slowly 'leach' into the sea water, killing barnacles and other marine life that have attached to the ship - but studies have shown that these compounds persist in the water,

[2] In doing so, the Commission will bear in mind, *inter alia*, the need for additional protection for North Sea ecosystems, in particular for spawning grounds and nursery areas for fisheries resources.

killing marine life, harming the environment and possibly entering the food chain. One of the most effective antifouling paints, developed in the 1960s to 1970s, contains the organotin tributyltin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks (IMO, 2000).

The harmful environmental effects of organotin compounds were recognised by the IMO (International Maritime Organisation) in 1990, when the Marine Environment Protection committee (MEPC) of IMO adopted a resolution which recommended that Governments adopt measures to eliminate the use of antifouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of antifouling paints with a leaching rate of more than 4 micro gram of TBT per day.

At present the MEPC's anti-fouling Working Group continued work on developing a legal instrument to regulate the use of shipboard anti-fouling systems, in particular to phase out those containing organotins such as TBT. The IMO Assembly in November 1999 approved to hold a Ministerial level conference in 2001 to adopt the proposed instrument. The Working Group has already developed the basic structure of a proposed legal instrument which will in effect phase out organotins acting as biocides in antifouling systems on ships, while the Assembly adopted resolution A.895 (21) 'Anti-fouling systems used on ships'. The resolution states that the MEPC should develop a global, legally-binding instrument to address the harmful effects of anti-fouling systems used on ships. It adds that the global instrument should ensure a global prohibition on the application of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition of the presence of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2008 (IMO, 2000).

In the Esbjerg Declaration (4th North Sea Conference) the Ministers concluded that more stringent goals and measures concerning TBT are urgently needed. Aiming a world-wide phasing-out of the use of TBT on all ships, the Ministers agreed to undertake concerted action with the IMO. If no adequate progress has been made before the end of 1997 within IMO, the Ministers agreed to consider solutions based on the phasing out of the use of TBT on ships flying the North Sea States‘ flags trading exclusively within the North Sea area. Furthermore the Ministers promote environmentally safe antifouling technologies (ICPNS, 1995).

Organic tin compounds are also on the OSPAR List of Chemicals for Priority Action (see above) (OSPARCOM, 1998 c).

HELCOM has prepared a special recommendation concerning antifouling paints containing organotin compounds (HELCOM, 1999). HELCOM recommends that the Governments of the Contracting Parties to the Helsinki Convention:

a. take effective measures to eliminate pollution caused by organotin compounds;
b. include in the measures taken, as a first step, a ban on the retail sale or use of organotin paints for pleasure boats or fish net cages,
c. consider the need for restrictions on other uses of organotin compounds in antifouling paints, for example on sea-going vessels and underwater structures.

Further HELCOM recommends that the Contracting Parties report on measures taken in accordance with this recommendation, and on organic tin concentrations in the marine environment in areas where organic tin compounds may still be entering the marine environment of the Baltic Sea Area in the year 2000 and thereafter every three years.

Finally HELCOM recommends that this recommendation should be reconsidered as soon as possible taking into account the development in other international fora (like IMO, EU).

4.2.4 International regulations concerning dredged material management

Dredging is essential to maintain navigation in ports and inland waterways and for the development of port facilities. Much of the material removed during these necessary activities requires disposal at sea. The greater proportion of the total amount of material dredged world-wide is, by nature, similar to undisturbed sediments in inland and coastal waters. However, a smaller proportion of dredged material is contaminated by human activity to an extent that major environmental constraints need to be applied when disposing these sediments (LC, 2000; OSPARCOM, 1998b; IADC/ CEDA, 1999).

Several guidelines or recommendations about the management of dredged material have been developed by different conventions, namely by LC (2000), PIANC (1997 & 1998), IADC/CEDA (1997c & 1999), OSPARCOM (1998a) and HELCOM (1992). A guidance on assessment of sediment quality is also developed under the auspices of the Programme of Global Investigation of Pollution in the Marine Environment (GIPME), which is co-sponsored by the Intergovernmental Oceanographic Commission (IOC), the United Nations Environment Programme (UNEP) and IMO (1999). Moreover, the ICES Working Group on Biological Effects of Contaminants dealt with the biological assessment of toxicity of marine dredged material in March 2000 in Nantes, France (ICES, 2000).

Dredged material management was an item of the OSPAR Working Group on Sea-based Activities (SEBA), at present it belongs to the Co-ordinating Committee (CC).

There are a number of dredging activities which may give rise to the need to dispose of sediments. These include:

a. Capital dredging - for navigation, to enlarge or deepen existing channel and port areas or to create new ones; and for engineering purposes; e.g. trenches for pipes, cables and immersed tube tunnels, removal of material unsuitable for foundations, removal of overburden for aggregate extraction;

b. Maintenance dredging - to ensure that channels, berths or construction works are maintained at their designed dimensions (i.e. counteracting sedimentation and changes in morphology); and

c. Clean-up dredging - deliberate removal of contaminated material from the marine environment for human health and environmental protection purposes (OSPARCOM, 1998b; LC, 2000).

Before beginning a full assessment of the material and the disposal options the question should be asked whether dredging is necessary In the event of a subsequent full assessment indicating no acceptable options for disposal it will be necessary to re-address this question in a broader context.

4.2.4.1 Objectives of guidelines and target audience

The general objective of the dredged material management guidelines is to provide a framework for good management practice when dealing with contaminated dredged material (see e.g. PIANC, 1997). The guidelines are designed to assist each Contracting Parties in the management of dredged material in ways that will prevent and eliminate pollution and thus protect the maritime area (see OSPARCOM, 1998b; HELCOM, 1992). In accordance to the mandate of the convention the guidelines either specifically address the disposal of dredged material by disposal in the maritime area (OSPARCOM, 1998b; LC, 2000; HELCOM, 1992), in other water bodies (PIANC, 1997 & 1998) or they also consider land disposal (PIANC, 1997).

It is recognised that both removal and disposal of dredged sediments may cause harm to the marine environment (OSPARCOM, 1998b). The 'Best Environmental Practice' (BEP) is required both for dredging and disposal (OSPARCOM, 1998b; HELCOM, 1992). Advice on environmentally acceptable dredging techniques is available from a number of international organisations e.g. OSPAR (SEBA, 1999), PIANC and IADC/CEDA.

In the context of these guidelines, dredged materials are deemed to be sediments or rocks with associated water, organic matter etc. removed from areas that are normally or regularly covered by water, using dredging or other excavation equipment. And disposal or aquatic disposal of dredged material means any deliberate disposal of dredged material either in maritime or estuary area or in rivers from vessels, from aircraft or from offshore installations (compare OSPARCOM, 1998b).

The target audience for the guidelines comprise the managers of ports and other organisations responsible for the maintenance of waterways and their navigation, relevant policy makers, regulators and related governmental and non-governmental organisations (PIANC, 1997 & 1998; IMO, 1999).

A flow-diagram of dredged material management following that one from the Dredged Material Assessment Framework (DMAF; LC, 2000) is given in figure 4-2.

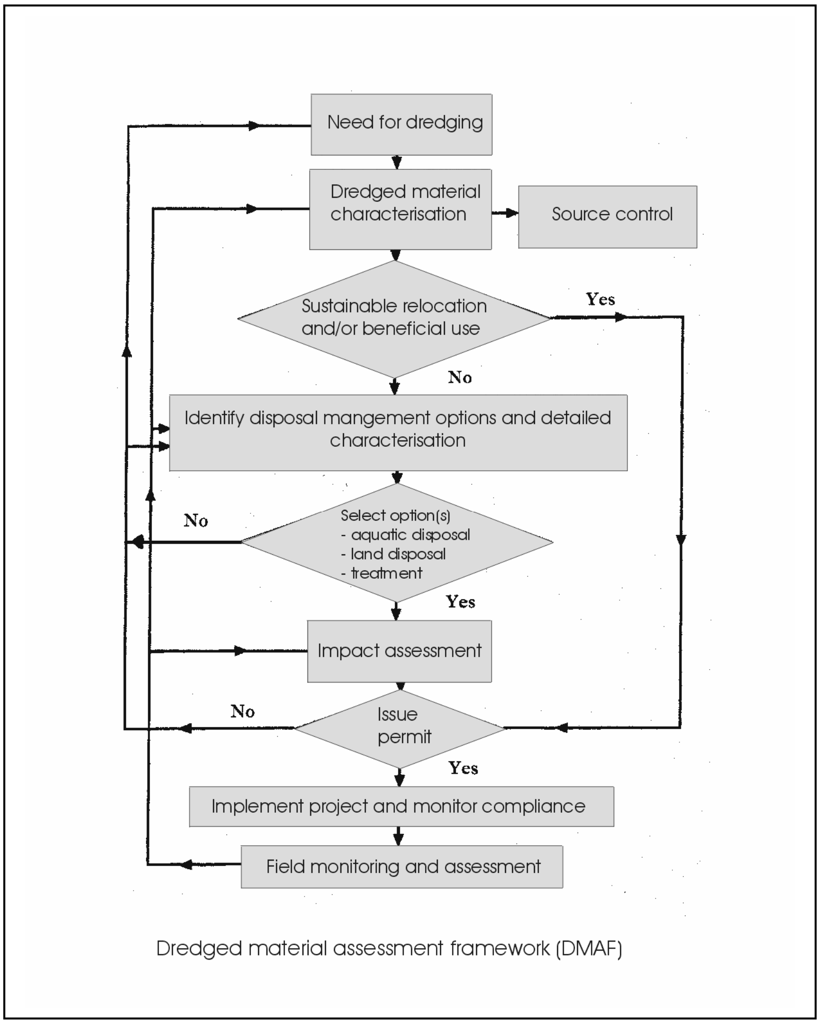


Figure 4-2: Flow-diagram of dredged material management (DMAF; LC, 2000)

4.2.4.2 Dredged material characterisation incl. sampling

For the purpose of issuing a disposal permit the sampling of sediments from the proposed dredging site shall be representative of the vertical and horizontal distribution and variability of properties of the materials to be dredged. It shall also reflect the size and depth of the area to be dredged and the amount to be dredged. A survey of the area to be dredged shall be carried out. Recommendations of the number of separate sampling stations, assuming a reasonably uniform sediment in the area to be dredged are listed in table 4-2 (OSPARCOM, 1998b; HELCOM, 1992). The number of stations should be adjusted according to the exchange characteristics of the area, e.g. less for open areas and more for enclosed and semi-enclosed areas. The sampling procedures should also anticipate the information that is needed for the evaluation and selection of the dredging, disposal and, if appropriate, treatment techniques and the necessary source control program (PIANC, 1997; OSPARCOM, 1998b).

Core samples should be taken where the depth of dredging and expected vertical distribution of contaminants suggest that this is warranted. In other circumstances, grab sampling will usually be sufficient. Sampling from disposal vessels or barges is not advisable for permitting purposes.

Table 4-2 : Number of separate sampling station in relation to amount dredged (OSPARCOM, 1998b; HELCOM, 1992)

Amount dredged (m3)	Number of Stations
Up to 25 000	3
25 000 - 100 000	4 – 6
100 000 - 500 000	7 – 15
500 000 - 2 000 000	16 – 30
>2 000 000	Extra 10 per million m3

Normally, the samples from each location should be analysed separately. However, if the sediment is clearly homogeneous with respect to sediment features (grain size, fractions and organic matter) and expected level of contamination, it may be possible to composite samples from adjacent locations, two or more at a time, provided care has been taken to ensure that the results give a justified mean value for the contaminants.

The frequency of sampling depends on the degree of contamination. If the results of the analyses indicate that the material is essentially 'clean', sampling in the same area need not be repeated more frequently than once every 3 years, provided that there is no indication that the quality of the material has deteriorated. In areas where there is a tendency for sediments to exhibit high levels of contamination, analysis of all the relevant determinants should be frequent and linked to the permit renewal procedure (OSPARCOM, 1998b; HELCOM, 1992).

If there is a need for dredging, a tiered evaluation of the physical (first tier), chemical (second tier), and biological characteristics (third tier) of the dredged material will be necessary to determine potential dredging methods, beneficial use, aquatic or land-based disposal, treatment, potential environmental impacts, further extent of chemical and/or biological testing requirements; and the necessity and contents of a source control program.

It is envisaged that developments in biological testing techniques might eventually provide sufficient information to assess the potential impact of the contaminants in the material, so that less reliance would need to be placed on chemical testing (OSPARCOM, 1998b).

Physical Characterisation

The basic physical characteristics include the amount of material, particle size distribution, specific gravity of solids and organic matter (OSPARCOM, 1998b; LC, 2000; PIANC, 1997 & 1998; HELCOM, 1992; IDAC/CEDA, 1999). The grain size and percent solids indicate the cohesiveness, settling velocity/ re-suspension potential and also the contaminant accumulation potential. The density/ specific gravity gives information about the consolidation of placed material and the volume *in situ* vs. after disposal. From the content of organic matter one can conclude the potential accumulation of organic associated contaminants (OSPARCOM, 1998b).

Dredged material may be exempted from further chemical and biological testing if any of the criteria below are met (OSPARCOM, 1998b; LC, 2000; PIANC, 1997 & 1998; HELCOM, 1992):

a. it is composed of previously undisturbed geological material; or

b. it is composed almost exclusively of sand, gravel or rock; or

c. in the absence of appreciable pollution sources, which should be supported by existing local information so as to provide reasonable assurance that the dredged material has not been contaminated, the quantity of dredged material from single dredging operations does not exceed 10 000 tonnes per year.

Dredged material that does not meet one of these requirements will need further stepwise characterisation to assess its potential impact.

Chemical Characterisation

If sufficient information for chemical characterisation is available from existing sources, new measurements may not be required of the potential impact of similar material in the vicinity, provided that this information is still reliable and has been obtained within the last 5 years.

In table 4-3 trace metals which should be determined in all cases (OSPARCOM, 1998b; HELCOM, 1992; see also PIANC, 1998) are listed.

Table 4-3: Trace metals which should be determined (OSPARCOM, 1998b)

Cadmium (Cd)	Copper (Cu)	Mercury (Hg)	Zinc (Zn)
Chromium (Cr)	Lead (Pb)	Nickel (Ni)	

The following organic/organo-metallic compounds should be determined (OSPARCOM, 1998b; HELCOM, 1992):

- Polychlorinated biphenyl (PCB) congeners - IUPAC nr. 28, 52, 101, 118, 138, 153 and 180;
- Polycyclic aromatic hydrocarbons (PAHs);
- Tributyl tin compounds and their degradation products.

The determination of PCBs, PAHs and tributyltin compounds and its degradation products will not be necessary if (OSPARCOM, 1998b):

a. sufficient information from previous investigations indicating the absence of contamination is available; or
b. there are no known significant sources (point or diffuse) of contamination or historic inputs; and
    - the sediments are predominantly coarse; and
    - the content of total organic carbon is low.

Considerations for additional chemical characterisation of dredged material are as follows (OSPARCOM, 1998b; LC, 2000):

a. major geo-chemical characteristics of the sediment including redox status;
b. potential routes by which contaminants could reasonably have been introduced to the sediments;
c. industrial and municipal waste discharges (past and present);
d. probability of contamination from agricultural and urban surface runoff;
e. spills of contaminants in the area to be dredged;
f. source and prior use of dredged materials (e.g., beach nourishment); and
g. natural deposits of minerals and other natural substances.

Based upon local information of sources of contamination (point sources or diffuse sources) or historic inputs, other determinants may require analysis, examples are listed in table 4-4 (compilation from OSPARCOM (1998b) and HELCOM (1992)).

Table 4-4: Substances which might be necessary to determine (OSPARCOM, 1998b and HELCOM, 1992)

Arsenic	Organochlorine pesticides	other organotin compounds	petroleum hydrocarbons
Other chlorobiphenyls (IUPAC Nos 18, 31, 44, 66/96, 110, 149, 187 and 170)	Organophosphorus pesticides	other anti-fouling agents	polychlorinated dibenzodioxins (PCDDs)/ polychlorinated dibenzofurans (PCDFs)

In deciding which individual organic contaminants to determine, reference should be made to existing priority substance lists, such as those prepared by OSPAR and the EU (chapter 4.2.4). Radioactive materials are for the majority of navigation dredging projects not a concern.

At each stage of the assessment procedure account must be taken of the method of analysis. Analytical techniques, storage and pre-treatment of samples are recommended referring to other guidelines. Analysis should be carried out on the whole sediment (< 2 mm) or in a fine-grained fraction, because the fine-grained fraction is prone to sequestering chemicals (GIPME, 1999). If analysis is carried out in a fine-grained fraction, the results should be appropriately converted to whole sediment (< 2 mm) concentrations for establishing total loads of the dredged material.

For a reliable comparison of contaminant concentrations in dredged material with those in sediments at disposal or reference sites, as well as with action levels normalisation procedures are recommended (OSPARCOM, 1998b; IMO, 1999; HELCOM, 1992).

Biological characterisation

If the potential impacts of the dredged material to be disposed cannot be assessed on the basis of physical and chemical characterisation and biological information, biological testing is required. There is a need for biological information about the sediment at the dredging site, e.g. about pathogenic bacteria contamination and nuisance organisms[3]. In addition information about species known to occur in the area which might be affected and the potential effect of the material to be disposed on organisms is important. The HELCOM guideline (1992) states that, where it can be established that the material to be disposed is substantially similar in chemical and physical properties to the sediments at the proposed disposal site, the biological testing may not be necessary providing the cumulative impacts at the disposal site will not exceed the environmental management objectives for the area concerned. However, there is a general belief that chemical analyses do not provide sufficient assessment of the environmental risks of dredging disposal and that sediment bioassays are required as an additional tool to measure the toxicity of sediments (ICES, 2000; GIPME, 1999).

[3] That are organisms found at the dredging site, but not at the disposal site and if introduced to the disposal site, they are more successful than indigenous animals.

For the biological testing species should be considered that are appropriately sensitive and representative. The following aspects should be determined, where appropriate (PIANC, 1997 & 1998; OSPARCOM, 1998b; LC, 2000; IDAC/CEDA, 1999):

1. acute toxicity;
2. chronic toxicity such as long-term sub-lethal effects, covering an entire life cycle;
3. the potential for bioaccumulation; and
4. the potential for tainting.

In addition to that considering the report of Management of Aquatic Disposal of Dredged Material (PIANC 1998) genotoxicity and mutagenicity should be tested. However, the HELCOM guideline (1992) does not point out the potential of tainting.

The selection of an appropriate suite of biological test methods will depend on the particular questions addressed, the level of contamination at the dredging site and the degree to which the available methods have been standardised and validated.

To enable the assessment of the test results, an assessment strategy should be developed as precondition to granting a permit authorising disposal at sea. The extrapolation of test results on individual species to a higher level of biological organisation (population, community) is still very difficult and requires good knowledge of assemblages that typically occur at the sites of interest (OSPARCOM, 1998b). Only the OSPARCOM guideline specifies the biological testing in its Annex I (1998) as follows:

1. Toxicity bioassays

The primary purpose of toxicity bioassays is to provide direct measures of the effects of all sediment constituents acting together, taking into account their bioavailability. For ranking and classifying the acute toxicity of port sediment prior to maintenance dredging, short-term bioassays may often suffice as screening tools.

- To evaluate the effects of the dredged material, acute bioassays can be performed with pore water, an elutriate or the whole sediment In general, a set of 2-4 bioassays is recommended with organisms from different taxonomic groups (e.g. crustaceans, molluscs, polychaetes, bacteria, echinoderms);
- In most bioassays, survival of the test species is used as an endpoint. Chronic bioassays with sub-lethal endpoint (growth, reproduction etc) covering a significant portion of the test species life cycle may provide a more accurate prediction of potential impact of dredging operations. However, standard test procedures are still under development;

The outcome of sediment bioassays can be unduly influenced by factors other than sediment-associated chemicals. Confounding factors like ammonia, hydrogen sulphide, grain size, oxygen concentration and pH should therefore be determined during the bioassay.

Guidance on the selection of appropriate test organisms, use and interpretation of sediment bioassays is given by e.g. EPA/CE (1991 & 1994) and IADC/CEDA (1997) while guidance on sampling of sediments for toxicological testing is given by e.g. ASTM (1994).

2. Biomarkers

Biomarkers may provide early warning of more subtle (biochemical) effects at low and sustained levels of contamination. Most biomarkers are still under development but some are already applicable for routine application for dredged material or for biomonitoring (e.g. DNA strand/breaks in flat fish).

3. Microcosm experiments

There are short-term microcosm tests available to measure the toxicant tolerance of the community e.g. 'Pollution Induced Community Tolerance' (PICT) (Gustavson & Wangberg, 1995)

4. Mesocosm experiments

In order to investigate long-term effects, experiments with dredged material in mesocosms can be performed, for instance to study the effects of PAHs in flatfish pathology. Because of the costs and time involved these experiments are not applicable in the process of authorising permits but are useful in cases where the extrapolation of laboratory testing to field condition is complicated or environmental conditions are very variable and hinder the identification of toxic effects as such. The results of these experiments would be then available for future permitting decisions.

5. Field observation of benthic communities

Monitoring in the surrounding of the disposal site of benthic communities e.g. in situ (fish, benthic invertebrates) can give important clues about the condition of marine sediments and are relevant as a feed-back or refinement process for authorising permits. Field observations give insight into the combined impact of physical disturbance and chemical contamination. Guidelines on the monitoring of benthic communities are provided by e.g. OSPAR, ICES, HELCOM.

6. Other biological properties

Where appropriate, other biological measurements can be applied in order to determine e.g. the potential for bioaccumulation and for tainting.

At the meeting of the ICES Working Group on Biological Effects of Contaminants (ICES, 2000) the present status of the use of bioassays in dredged material assessment was presented by scientists from The Netherlands, the United Kingdom and France. The following points were summarised as the consensus on biological assessment of dredged materials:

1. Validated bioassays are required in cases where toxicity assessment of dredged material is relevant and supplements chemical analysis.
2. The selection of appropriate bioassays is driven by costs, ecological relevance, time constraints, sensitivity, robustness and local preferences.
3. Analytical chemistry alone can be used to define an upper cut off point above which sea disposal should not occur.
4. Assessment criteria should generally be defined in terms of biological significance, not solely by statistical significance.

5. Because of the differences in ecotoxicological responses to chemicals among species, the use of a suite of bioassays is needed.
6. In addition to the use of bioassays, there is a need to assess the overall impacts at disposal sites, e.g. by investigations of benthic community structure.
7. Great care is needed with sediment sampling, including standardisation, to obtain representative samples.
8. There is a need to account for the presence and possibly the effects of persistent and/ or bioaccumulative substances.
9. There is a need to develop the use of biomarkers in dredged material bioassays in order to increase sensitivity and contaminant-specificity.

It was concluded that the following points require more research (ICES, 2000):

1. Whether it is possible to define a lower chemical cut-off point that conservatively triggers the application of bioassays.
2. Whether chronic bioassays add useful knowledge.
3. In which cases are bioaccumulation tests with dredged material required, or is partition modelling sufficient?
4. Do bioassays with elutriates and pore waters add useful information to that obtained from whole sediment tests?
5. Is there value in Toxicity Identification and Evaluation (TIE) techniques for evaluating causes of toxicity?

In addition there was consensus that in-situ bioassays, i.e. deployment of a biological 'system' at the site of choice in the field environment, have an important role in bridging the gap between laboratory experimentation and field validation. The biological system may be a small community of organisms, individuals or in some instances colonising substrates, and the end points numerous e.g. biomarkers, physiology, behaviour, growth, reproduction and mortality (ICES, 2000).

It is the task of regulatory authorities to determine the limits of acceptable biological responses to chemical contamination. This will vary according to the location and spatial scale of contamination, and on local management objectives and socio-economic judgements. If the objective is to avoid alterations to biochemical processes in individual organisms, less contamination can be accepted than in the case of an objective that aims to sustain populations of commercial species (GIPME, 1999).

4.2.4.3 Action List

The Action List is used as a screening mechanism for assessing properties and constituents of dredged material with a set of criteria for specific substances. An Action List and respective guidelines could be devised as a trigger mechanism for dredged material management decisions, including the identification and development of source control measures. The criteria should reflect experience gained relating to the potential effects on human health or the marine environment (OSPARCOM, 1998b; PIANC, 1997).

Action List levels should be developed on a national, regional or local basis. They might be set on the basis of concentration limits, biological responses, environmental quality standards, flux considerations or other reference values. They should be derived from studies of sediments that have similar geochemical properties to those from the ones to be dredged and/or to those of the receiving system. Thus, depending upon natural variation in sediment geochemistry, it may be necessary to develop individual sets of criteria for each area in which dredging or disposal is conducted. With a view to evaluating the possibilities for harmonising or consolidating the criteria referred to above, Contracting Parties of OSPAR are requested to inform the OSPAR Commission through SEBA (OSPAR Working Group on Sea Based Activities) of the criteria adopted, as well as the scientific basis for the development and refinement of these criteria.

An Action List may include an upper and lower level giving these possible actions (OSPARCOM, 1998b; PIANC, 1997):

a. material which contains specified contaminants or which causes e.g. biological responses, in excess of the relevant upper levels should generally be considered unsuitable for disposal at sea;
b. material which contains specified contaminants or which causes e.g. biological responses, below the relevant lower levels should generally be considered of little environmental concern for disposal at sea; and
c. material of intermediate quality should require more detailed assessment before suitability for disposal at sea can be determined.

If dredged material is disposed of at sea when one or more criteria exceed the upper level, a Contracting Party of OSPAR should:

a. where appropriate, identify and develop source control measures with a view to meeting the criteria; and
b. utilise disposal management techniques, including the use of containment or treatment methods, to mitigate the impact of the disposal operation on the marine environment; and
c. report the fact to the Secretariat of OSPAR, including the reason for permitting the disposal, in accordance with the requirements of the format for the Annual Reporting of Dumping Permits Issued.

4.2.4.4 Evaluation of disposal options and beneficial uses

The results of the physical, chemical and biological characterisation will indicate whether the dredged material, in principle, is suitable for disposal at sea. Where sea disposal is identified as an acceptable option, it is nonetheless important, recognising the potential value of dredged material as a resource, to consider the availability of beneficial uses (OSPARCOM, 1998b).

In the dredged material management guide of PIANC (1997) it is pointed out, that in many cases dredged material is merely trapped marine or fluvial sediment that would, in absence of the ports and deepened waterways, normally contribute to the suitable development of nature. Therefore the value of this natural material with regard to river, coastal zone and estuarine management should not be underestimated. As impact studies have shown, the environmental effects of removing the sediment from the marine system may, in specific cases, be more harmful than the effects of placing slightly contaminated dredged material back into the system. But sustainable relocation requires proper environmental impact studies, site selection, monitoring and evaluation. If the dredged material is clean or slightly contaminated, and there is no reason for relocation, it can be considered for beneficial use.

Beneficial uses

Beneficial use is defined as placement or use of dredged material for some productive purpose (PIANC, 1998). It may involve either dredged material or the placement site as an integral component of the beneficial use scheme.

There is a wide variety of beneficial uses depending on the physical and chemical characteristics of the material. Generally, a characterisation carried out in accordance with these guidelines will be sufficient to match a material to possible uses such as:

a. Engineered uses - land creation and improvement, beach nourishment, offshore berms, capping material and fill;
b. Agricultural and product uses - aquaculture, construction material, liners; and
c. Environmental enhancement - restoration and establishment of wetlands, terrestrial habitats, nesting islands, and fisheries.

The technical aspects of beneficial uses are well-established and described in the literature – see e.g. Beneficial Uses of Dredged Material: a Practical Guide (PIANC, 1992), IDAC/CEDA, 1999.

Treatment

For contaminated dredged material a treatment might be necessary, i.e. a way of processing contaminated dredged material with the aim of reducing the amount of contaminated material (e.g. separation) or reducing contamination to meet regulatory standards and criteria (e.g. by means of extraction or fixation). After the treatment e.g. after separation beneficial use might be possible for the 'clean' fraction. Treatment processes can in general be classified as: pre-treatment, biological, chemical, thermal, electrokinetic and immobilisation (IDAC/CEDA, 1999; PIANC, 1997). The costs of the treatment process should take the effectiveness into account. Whereas the effectiveness of treatment technique must be based on residual contents in the cleaned dredged material, on energy and chemical consumption, and on the production of waste flows and cleaning residues (PIANC, 1997).

Aquatic disposal

When neither sustainable relocation nor beneficial use options are appropriate, either aquatic or land-based disposal is usually the only remaining option. The conventions for the protection of the sea prohibit disposal of waste in the sea but disposal of dredged material is one of the exemptions (OSPARCON, 1992; HELCON, 1992; LC, 1972). However, disposal of dredged material is only allowed following the guidelines and meeting the permission requirements.

For aquatic disposal first a characterisation of the disposal site is needed to decide if it is suitable (site selection) and to provide benchmark data for assessing the effects of the disposal (monitoring). The selection of a site for sea disposal involves considerations of an environmental nature (physical, chemical and biological properties) and also economic (functional) and operational feasibility. Site selection should try to ensure that the disposal of dredged material does not interfere with, or devalue, legitimate commercial and economic uses of the marine environment nor produce undesirable effects on vulnerable marine ecosystems.

Functional uses of the receiving area may include: nature conservation and other protection areas; fishing; aquaculture; recreation; shipping; mining of sand, minerals and shells; engineering uses; military exercise zones; previous disposal; water body as recipient for other environmental loads and other functions (PIANC, 1998; OSPARCOM, 1998b).

The most important physical characteristics include: Geology and geohydrology; Sub-aqueous forms; Sub-aqueous soils; Hydrodynamic conditions; Water column characteristics; Sediment transport. Chemical site characterisation must be done in that way, that a basis from which to assess the impact of the disposal is provided. Biological site characterisation might include: Fisheries; Planktonic species; Benthic vegetation; Benthic fauna; Mammals and birds. Whereas particular attention should be paid to: Spawning and nursery grounds; Known migration routes of fish and marine mammals; Areas of special scientific or biological interest (including nature conservation areas); Marine sanctuaries; Presence of unique, rare or endangered, or isolated populations, Potential for recolonisation (PIANC, 1998).

The information on the characteristics of the sea disposal site referred to above is required to determine the probable fate and effects of the disposed material. The physical conditions in the vicinity of the sea disposal site will determine the transport and fate of the dredged material. The physico-chemical conditions can be used to assess the mobility and bioavailability of the chemical constituents of the material. The nature and distribution of the biological community and the proximity of the site of sea disposal to marine resources and amenities will, in turn, define the nature of the effects that are to be expected. Careful evaluation will allow determination of environmental processes that may dominate the transport of material away from the sea disposal site. The influence of these processes may be reduced through the imposition of permit conditions (OSPARCOM, 1998b).

In some cases, disposal can augment existing effects attributable to inputs of contaminants to coastal areas through land runoff and discharge, from the atmosphere, resource exploitation and maritime transport. These existing stresses on biological communities should be considered as part of the assessment of potential impacts caused by disposal. The proposed method of disposal and potential future uses of resources and amenities in the marine receiving area should also be taken into account (OSPARCOM, 1998b).

Assessment of Potential Effects

Assessment of potential effects should lead to a concise statement of the expected consequences of the disposal option (i.e., the 'Impact Hypothesis'). Its purpose is to provide a basis for deciding whether to approve or reject the proposed disposal option and for defining environmental monitoring requirements (LC, 2000; OSPARCOM, 1998b).

This assessment should integrate information on the characteristics of the dredged material and the proposed disposal site conditions. It should comprise a summary of the potential effects on human health, living resources, amenities and other legitimate uses of the sea and should define the nature, temporal and spatial scales and duration of expected impacts based on reasonably pessimistic assumptions.

In order to develop the hypothesis, it may be necessary to conduct a baseline survey which describes not only the environmental characteristics, but also the variability of the environment. It may be helpful to develop sediment transport, hydrodynamic and other models, to determine possible effects of disposal.

Aquatic disposal will produce physical and chemical changes at the point of disposal which my result in changes in the community structure of species and in distribution, abundance and biomass of individual species. Effects will be predominantly physical in nature and may be both permanent and transitory. Permanent effects include changes in morphology of the bottom surface and, depending on the sediment characteristics, effects on the whole habitat of the water body. Possible transitory effects include turbidity and smothering of living organisms (PIANC, 1998). Physical impact may also result from the subsequent transport, particularly of the finer fractions, by wave and tidal action and residual current movements.

In comparatively rare circumstances, the physical impacts can also interfere with the sensory capabilities therefore the migration of fish (e.g. the impact of high levels of turbidity on salmonids in estuarine areas) or crustacean (e.g. if disposal occurs in the coastal migration path of crabs) which e.g. fail to find spawning grounds or food (OSPARCOM, 1998b).

Further the toxicological and bioaccumulation effects of dredged material constituents should be assessed. Disposal of seriously contaminated material has more potential for harm because the chemical contaminants can have both immediate and long-term adverse effects on the aquatic ecosystem (ecotoxicological effects), and ultimately, via the food chain, on human health (PIANC, 1998). But also disposal of sediments with low levels of contamination is not devoid of environmental risk and requires consideration of the fate and effects of dredged material and its constituents. Substances in dredged material may undergo physical, chemical and biochemical changes when entering the marine environment and these changes should be considered in the light of the eventual fate and potential effects of the material (OSPARCOM, 1998b).

Moreover in relatively enclosed waters, such as some estuarine and fjordic situations, sediments with a high chemical or biological oxygen demand (e.g. organic carbon-rich) could adversely affect the oxygen regime of the receiving environment while sediments with high levels of nutrients could significantly affect the nutrient flux.

Another important consequence of the physical presence of dredged material disposal activities is interference with fishery activities and in some instances with navigation and recreation.

Particular attention should be given to dredged material containing significant amounts of oil or other substances that have a tendency to float following re-suspension in the water column. Such materials should not be disposed in a manner or at a location which may lead to interference with fishing, shipping, amenities or other beneficial uses of the marine environment.

Therefore it is very important to carry out an appropriate site selection, respecting other legitimate uses of the water and minimising adverse effects. Management options e.g. the selection of a specific disposal method or disposal period should be considered to reduce possible adverse effects.

Land-based Disposal

When the dredged material is unsuitable for open water disposal, land-based confined or unconfined disposal has to be undertaken. The land-based proposal options can be categorised as (i) options completely above the (ground) water table and (ii) options partly or completely below the (ground) water table. The categories of sites differ with regard to the mechanism which cause the dispersion of contaminants from the disposal site and also the degree to which control can be exercised over the mechanisms. There are several major processes which determine the potential effects, e.g. expelled water/ advective transport of contaminants, and possible pathway, e.g. leaching and transport of contaminants into surrounding ground and surface waters. The confined disposal site management include several actions and evaluations, such as:

1. Implementation of guidelines and administrative procedures for the acceptance of dredged material, including environmental and physical parameters.
2. Monitoring of the physical and environmental parameters of the dredged material and the processes within the disposal site (consolidation, surplus water control, etc.).
3. Continuous optimisation of the disposal process and anticipation or reaction to changing environmental technologies and changing policies (PIANC, 1997).

4.2.4.5 Environmental Impact Assessment (EIA)

Before permitting a management option, an 'Environmental Impact Assessment' (EIA) is necessary (IADC/CEDA, 1999; PIANC, 1997). It provides a tool to evaluate all disposal options in terms of their environmental and human resources implications. It comprises e.g. a description of the baseline environmental and socio-economic characteristics, which is why a wide consultation exercise with competent authorities, interested groups and the public must be carried out. Also, a assessment of the impacts on the environment and human resources has to be done (PIANC, 1997).

4.2.4.6 Contaminant source evaluation and control

Contamination of estuarine and coastal marine sediments both as a consequence of historical and present day inputs presents a continuing problem for the management of dredged material. High priority should be given to the identification of sources, reduction and prevention of further contamination of sediments and should address both point and diffuse sources. Successful implementation of prevention strategies will require collaboration among national agencies with responsibility for the control of point and diffuse sources of contamination (OSPARCOM, 1998b).

In developing and implementing a source control strategy, appropriate agencies should take into account (OSPARCOM, 1998b):

a. the continuing need for dredging;
b. the hazards posed by contaminants and the relative contributions of the individual sources to these hazards;

c. existing source control programmes and other regulations or legal requirements;

d. the criteria for best available techniques (BAT) and best environmental practice (BEP) as defined in Appendix 1 of the 1992 OSPAR Convention (see chapter 4.2.4), *inter alia*, as regards the technical and economic feasibility;

e. the evaluation of the effectiveness of measures taken; and

f. consequences of not implementing contaminant reduction.

In cases where there has been historical contamination or where control measures are not fully effective in reducing contamination to acceptable levels, disposal management techniques, including the use of containment or treatment methods may be required.

4.2.4.7 Permit issues, monitoring and reporting

For many management options an authorising permit may need to be issued in advance. The conditions under which the permit is issued should be such that the environmental change beyond the boundaries of the disposal site are as far below the limits of allowable environmental change as practicable. The permitted operation should ensure that environmental disturbance and detriment are minimised and benefits are maximised (PIANC, 1997; OSPARCOM, 1998b; LC, 2000).

The permit is an important tool for managing disposal of dredged material and will contain the terms and conditions under which disposal may take place as well as provide a framework for assessing and ensuring compliance.

In case of sea disposal OSPARCOM (1998b) states that the permit conditions should be drafted in plain and unambiguous language and will be designed to ensure that:

a. only those materials which have been characterised and found acceptable for sea disposal, based on the impact assessment, are disposed;

b. the material is disposed of at the selected disposal site;

c. any necessary disposal management techniques identified during the impact analysis are carried out; and

any monitoring requirements are fulfilled and the results reported to the permitting authority.

Finally, for the overall management of the site monitoring programmes are required. Monitoring in relation to disposal of dredged material is defined as measurements of compliance with permit requirements and of the condition and changes in condition of the receiving area to assess the Impact Hypothesis upon which the issue of a permit was approved (PIANC, 1998; OSPARCOM, 1998b). The Impact Hypothesis forms the basis for defining the monitoring programme. The measurement programme should be designed to ascertain that changes in the receiving environment are within those predicted. In designing a monitoring programme the following questions must be answered:

a. what testable hypotheses can be derived from the Impact Hypothesis?

b. what measurements (e.g. type, location, frequency, performance requirements) are required to test these hypotheses?

c. what should be the temporal and spatial scale of measurements?

d. how should the data be managed and interpreted?

The information gained from field monitoring can be used to e.g. modify or revoke the permit and refine the basis on which applications to manage dredged material are assessed in future (PIANC, 1997 & 1998; OSPARCOM, 1998b).

For the Contracting Parties of OSPAR reporting of permits issued and amounts of dredged material disposed together with the associated contaminants is required according to the 1992 OSPAR Convention. The characterisation process is designed to provide information for permit purposes. They should also inform the Secretariat of their monitoring activities and submit reports when they are available (OSPARCOM, 1998b).

4.3 International Commission for the Protection of the Rhine (ICPR)

In 1950 the 'International Commission of the Protection of the Rhine' (ICPR) was founded on the initiative of the Netherlands. The members are Switzerland, France, Luxembourg, Germany, the Netherlands and since 1976 the European Community. In 1963 the Commission‘s contract was based on the law of the nations (ICPR, 1999a). The actual legal basis of the Commission’s work, the new Rhine Convention, was passed in 1999.

The ICPR has the following objectives:

- sustainable development of the Rhine ecosystem;
- prevention of extraction of Rhine-water of drinking water;
- the sediment quality should be improved in order to enable the use or disposal of dredged material without causing environmental harm;
- ecological flood protection;
- protection of the North Sea.

The duties of the Commission are defined by ministerial resolutions (consensus principle) every two or three years. The group consists of high ranked officials of the member states. The resolutions of the Commission are not binding but should be implemented in the responsibility of the member states. The resolutions are prepared in three permanent working groups and two project groups (figure 4-3). The groups are composed of experts from the ICPR member states (ICPR, 1999a). At the 12th Rhine Conference of Ministers a new agreement about future co-operation was passed. NGOs and private companies, as for example the Port of Rotterdam, are allowed to take part in the work of the ICPR groups. They have the status of an consultant i.e. they have no vote in the Commission.

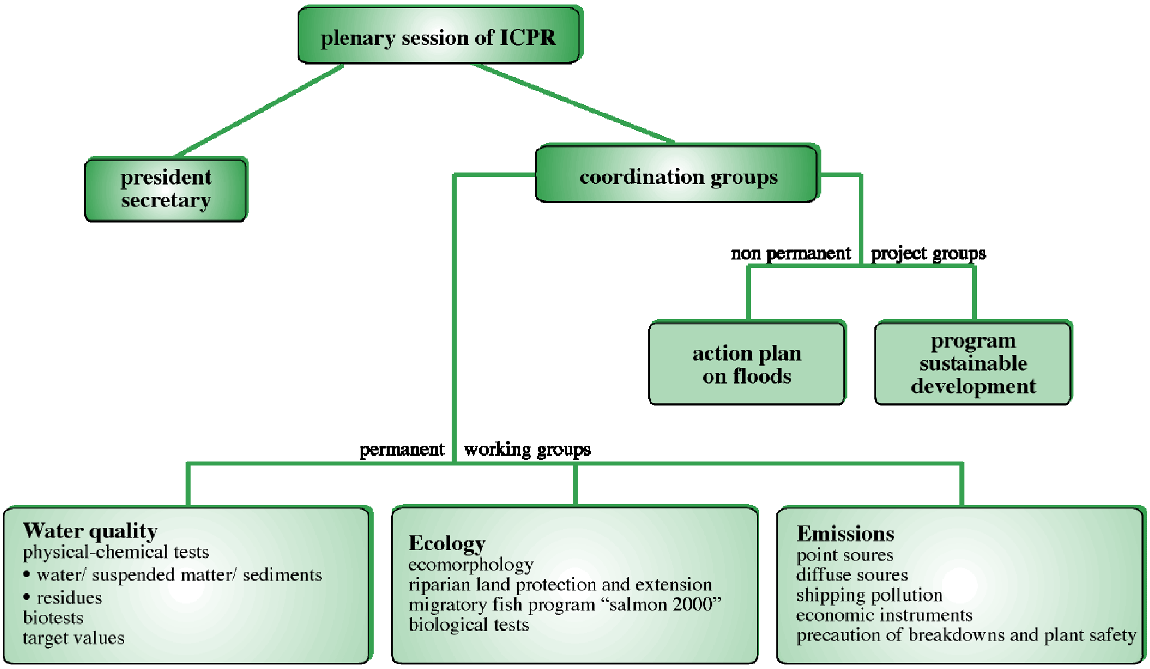


Figure 4-3: Working Structure of the International Commission of the Protection of the Rhine (ICPR, 1999a)

4.3.1 Regulations concerning water and sediment quality

For the enhancement of the water and sediment quality the Rhine Commission defined target values for groups of chemicals such as heavy metals, pesticides, drins, volatile and non-volatile hydrocarbons, PAH, PCB and further particular substances (see appendix 4.3 a). The impacts of these substances are tested concerning the

- quality of drinking water;
- human consumption of fish,
- aquatic organisms (Braun, 2000a).

Furthermore the regulations about disposed dredged material into the North Sea and the land use of dredged sediments are taken into consideration. At least the lowest concentration of pollutants which cause negative effects on these five factors is chosen as target value for the River Rhine. These target values are not legally binding.

Not only the target values but also the priority list of pollutants is permanently revised by the Commission (see appendix 4.3 b). The last contains substances which concentrations are thought to be problematic for aquatic organisms, the quality of drinking water and sediments.

One of the objects of the ICPR is to achieve such a sediment quality of the River Rhine that all the dredged material can be disposed into the North Sea. But although the water quality of the River Rhine is enhanced significantly during the last 20 years – the actual concentrations of heavy metals in water (including suspended matter) are lower than the European Threshold for drinking water - the concentrations of heavy metals (except mercury) in the sediments of the upper Rhine are still frequently higher than the Dutch thresholds for disposal material into the North Sea (see figure 4-4). With regard to some PAHs and PCBs the Dutch pollution threshold was also exceeded. Not the point sources, as in former days, but diffuse sources, such as urban storm water discharges, soil erosion and drainage are thought to be the main sources of sediment pollution (Braun, 2000a).

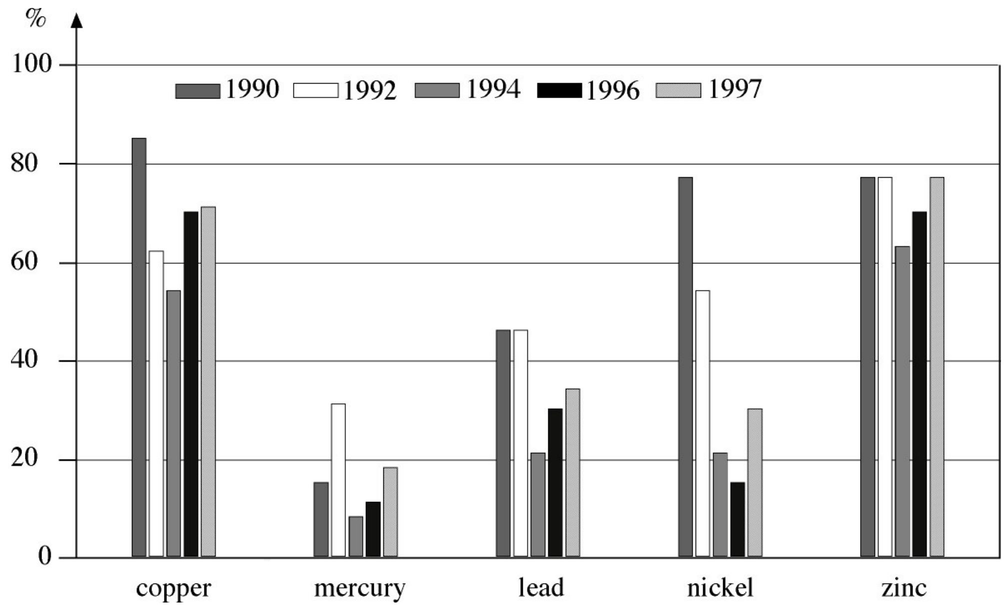


Figure 4-4: Heavy metal concentrations in the upper river Rhine sediments – percentage of exceedings of the Dutch test values concerning the relocation of dredged material to the North Sea, 1990-1997 (Braun, 2000c)

4.3.2 Regulations concerning emission control

Due to the industrial accident of the company 'Sandoz' on November 1, 1986, the ministers of the River Rhine riparian states decided to establish an ad-hoc working group that had to work out a Rhine Action plan. The following targets were set for the year 2000 (ICPR, 1987):

- to reintroduce higher developed species to the fluvial system Rhine, such as salmon;
- to sustain the River Rhine as a drinking water resource;
- to reduce the contamination level of the sediments.

The action plan included measures

- to improve the reduction of emissions from point and diffuse sources;
- to reduce the danger of contamination due to industrial accidents;
- to improve the hydrological, biological and morphological status of the fluvial system Rhine.

In 1987 a list of priority substances was developed. From 1985 to 1995 the emissions of these substances into the River Rhine were had to be reduced by 50 % (ICPR, 1987).

The actions to reduce the emissions from point sources into the River Rhine were quite successful. Table 4-5 shows the results of reductions rates of priority substances (defined between 1987 and 1991) for the period 1985 to 1995 (pesticides, highly volatile hydrocarbons, nutrients and AOX are not listed).

Table 4-5: Emission reduction (in %) of selected priority substances into the River Rhine 1985-1995 (ICPR, 1999b)

Priority substance	**90-100%**	**89-80%**	**79-70%**	**40-0%**
Cadmium	*			
Chromium	*			
Nickel		*		
Lead		*		
Mercury			*	
Copper			*	
Zinc			*	
Arsenic				*1
PCB	*			
1 the reference year is 1992				

Overall the significant reduction of pollutant emissions into the River Rhine was quite successful in the last 15 years. Therefore other topics than pollution reduction such as flood protection or the ecological improvement of the river basins became more important. During the last two years the ICPR elaborated a programme for the 'Sustainable Development of the River Rhine' and a working plan until the year 2005 will be developed with the participation of NGOs and representatives from different industries (both have only consultative rights). So it is very likely that the ICPR will be one of the important institutions to establish the river basin management plans required by the EU-WFD (see chapter 4.1.1).

The sustainable development includes the following objectives (ICPR, 2000):

- improvement of the ecosystem: extending connected biotopes, biodiversity, establishing protected areas, reactivating flood areas, opening former tributaries;
- improvement of water quality: the target values for pollutants in water, suspended matter and sediments should be achieved (see appendix 4.3 a). The OSPAR resolution 1998 in Sintra has been adopted. The environmental concentration of hazardous substances is obliged to be reduced to background values or to zero for industrially synthesised substances;
- action plan for floods: reduction of damage risks by about 25% compared to actual risks, reactivation of flood areas and new constructions for flood protection;
- protection of groundwater: the aim is an area-wide good groundwater quality and groundwater extraction should be lower than the groundwater recharge;
- the measures must agree with the international conventions (ICPR, 2000).

The following instruments are to be used:

- European Community directives, such as, for example, the IPPC-Directive (see chapter 3), the Waste Water Directive,
- ecotoxicological assessments,
- environmental management systems, for example ISO 14001,
- ecological production systems in industry and trade,
- ecological agriculture,
- co-operation with the public.

The costs for the implementation of the 'Rhine 2020 Program' have to be paid by the member states (ICPR, 2000).

4.3.3 Dredged material management

In 1995 the water quality working group analysed the national standards of the member states for the disposal of dredged material. It concluded that the content and the binding character of the national standards were very different. The national regulations were embedded in other laws, as for example, for waste, waterways, environment or nature protection. Moreover, the institutions responsible for dredged material were not represented in the Rhine Commission. In order to harmonise the management of dredged material several national laws had to be amended (ICPR, 1995).

In 1997 the ICPR defined qualitative criteria for the relocation of dredged material in the River Rhine and its tributaries. The criteria are based on the principle 'prevention of degradation'. An ecotoxicological assessment was not carried out because it is not yet internationally standardised (ICPR, 1997):

- Dredged material is allowed to be relocated only when the mean concentration of every pollutant is less than three times the mean concentration in suspended matter of three years before dredging occurred.
- The concentration of oxygen in the water must be higher than 4 mg/l.

- Relocations of dredged material are permitted only when the actual river flow is significantly above the mean longstanding minimum flow.
- Negative impacts on biotic communities have to be avoided (ICPR, 1997).

Although the International Rhine Commission is not concerned with the disposal of dredged material into the North Sea its work has a great influence on the quality of sediments transported by the Rhine and hence on the quality of dredged material in the port of Rotterdam.

References

ASTM (1994): Standard guide for collection, storage, characterisation and manipulation of sediment for toxicological testing. American Society for Testing and Material, Annual Book of Standards. Vol. 11.04, E1391-96.

Baumert, H.-P. (2000): Do we Need Regulations for Dredged Material in Europe? – Abstract of the Policy Workshop in the Frame of this Project, 17.-19.4.00, Rotterdam.

Braun, M. (2000a): Information about threshold and target values as well as priority substances defined by the International Rhine Commission (ICPR). 26.5.2000, Koblenz.

Braun, M. (2000b): Personal communication, July 3, Koblenz.

Braun, M. (2000c): Talk on the Port II Policy Workshop in Rotterdam about Dredged Material in Europe, April 16-19, Rotterdam.

Burt, N. (2000): Statement of CEDA Environment Steering Committee. April 18, Rotterdam.

CEDA (2000): Information from the web site of CEDA. Delft.

Council of the EC (European Communities) (1999): Common Position (EC) No 41/1999 adopted by the Council on 22.10.1999 with a view to the adoption of a Directive 1999/.../EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy. Official Journal of the European Communities, No. C 343, Brussels.

EC 75/442 EEC: Council Directive of 15 July on Waste. Official Journal L 194, 25/07/1975 p. 0039-0041.

EC 86/278/EEC: Council Directive of 12 June 1986 on the Protection of the Environment, and in particular of the Soil, when Sewage Sludge is Used in Agriculture. Official Journal L 181. 04/07/1986 p. 0006-0012.

EC 94/3/EC: Commission Decision of 20 December 1993 Establishing a List of Wastes pursuant to Article 1a of Council Directive 75/442/EEC on Waste. Official Journal. L 005, 07/01/1994 p. 0015-033.

EC 1999/31/EC: Council Directive of 26 April 1999 on the Landfill of Waste. Official Journal L 182, 16/07/1999 p. 0001-0019.

Ehlers, P. (1996): Das revidierte Helsinki-Übereinkommen. In: Koch, H.-J.; Lagoni, R. (eds.): Meeresumweltschutz für Nord- und Ostsee. Zum Zusammenspiel von Völkerrecht und nationalem Umweltrecht. Baden-Baden.

EPA/CE (1991): Evaluation of Dredged Material Proposed for Ocean Disposal: Testing Manual EPA-503/8-91/001. US-EPA Office of Water (WH-556F).

EPA/CE (1994): Evaluation of Dredged Material Proposed for discharge in Waters of the US. Testing Manual (draft): Inland Testing Manual EPA – 823-B-94-002. (will be replaced by 'coast of waters manual').

European Community (Europäische Gemeinschaft) (1997): Vertrag zur Gründung der Europäischen Gemeinschaft. Amtsblatt der Europäischen Gemeinschaft, C 340 vom 10.11.1997, Brüssel.

European Parliament/Council (2000): Directive 2000 – PE-CONS 3639/00/EC of the European Parliament and of the Council of EC establishing a framework for Community action in the field of water policy, June 30, Brussels.

GIPME (IOC-UNEP-IMO) (1999): Final Report on Guidance on Assessment of Sediment Quality.

Greenpeace Germany (2000): Information from the web site, October 12, 2000.

Greenpeace International (2000): Information from the web site, October 12, 2000.

Gustavson, K. and Wangberg, S. A. (1995): Tolerance induction and succession in microalgae communities exposed to copper and atrazine. Aquatic Toxicology. 32: 283-302.

HELCOM (1992): Revised Guidelines for the Disposal of Dredged Spoils.

HELCOM (1999): HELCOM Recommendation 20/4 concerning antifouling paints containing organotin compounds.

HELCOM (2000): Information from the secretariat of HELCOM. 6.04.2000, Helsinki.

HELCON (1992): Convention on the Protection of the Marine Environment of the Baltic Sea Area.

IADC/CEDA (1997a): Environmental Aspects of Dredging – Conventions, Codes and Conditions (Guide 2a). ISBN 90-75254-05-9.

IADC/CEDA (1997b): Environmental Aspects of Dredging – Conventions, Codes and Conditions: Land Disposal (Guide 2b). ISBN 90-75254-06-7.

IADC/CEDA (1997c): Environmental Aspects of Dredging. Guide 3 (Investigation, Interpretation and Impact). ISBN 90-75254-08-3.

IADC/CEDA 1999: Reuse, Recycle or Relocate. Guide 5. ISBN 90-75254-10-5.

IAPH (International Association of Ports and Harbors) (2000): Information from the web site, October 5, 2000.

ICES (ACME) 2000: Final draft: Report of the Working Group on Biological Effects of Contaminants, Nantes, France 27-31 March 2000.

ICES (2000): Information from the secretariat, 25.01.2000. Copenhagen.

ICPNS (2000): Information from the secretariat, 10.03.2000. Oslo.

IMO (1991): The London Dumping Convention – The First Decade and Beyond. London.

IMO (1997a): Dumping at Sea. The Evolution of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), 1972. London.

IMO (1997b): Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Convention 1972). Compilation of the full texts of the London Convention 1972 and of the 1996 Protocol thereto. LC.2/Circ.380, 12.3.1997, London.

IMO (2000): Information from the secretariat, 28.2.2000, London.

IMO (2000): Marine Environment Protection Committee – 44th session: 6-13 March 2000.

ICPNS (1995): Esbjerg Declaration – Ministerial Declaration of the Fourth International Conference on the Protection of the North Sea.

ICPR (1987): Aktionsprogramm 'Rhein', Straßburg.

ICPR (1995): Nationale Anforderungen an die Aufbringung und Ablagerung von Baggergut. Bericht Nr. 73, Koblenz.

ICPR (1997): Empfehlung zu den Kriterien für die Umlagerung von Baggergut in den Rhein und seine Nebengewässer. Bericht Nr. 89, Koblenz.

ICPR (1999a): Information from the web site of ICPR. Koblenz.

ICPR (1999b): Rhein – Bestandsaufnahme der Einträge prioritärer Stoffe 1996, Koblenz.

ICPR (2000): Rhein 2020: Programm zur nachhaltigen Entwicklung des Rheins und Arbeitsplan bis 2005. Entwurf vom 18.01.2000, Koblenz.

Kommission der Europäischen Gemeinschaften (EU) (2000): Entscheidung des Europäischen Parlaments und des Rates zur Festlegung der Liste prioritärer Stoffe im Bereich der Wasserpolitik. Kom (2000) 47 endgültig/2, 18.02.2000, Brüssel

Krämer, L.. (1996): Meeresumweltschutz im Recht der Europäischen Gemeinschaften. In: Koch, H.-J.; Lagoni, R. (eds.): Meeresumweltschutz für Nord- und Ostsee. Zum Zusammenspiel von Völkerrecht und nationalem Umweltrecht. Baden-Baden

Lagoni, R. (1996): Das OSPAR-Übereinkommen von 1992 und der Schutz der Nordsee: Einwirkungen auf das deutsche Umweltrecht. In: Koch, H.-J.; Lagoni, R. (eds.): Meeresumweltschutz für Nord- und Ostsee. Zum Zusammenspiel von Völkerrecht und nationalem Umweltrecht. Baden-Baden

Lanz, K.; Pollard, P.; Simpson (2000): The European Parliaments 2nd Reading of the Water Framework Directive. Prepared for European NGOs: Bird Life International, the European Environmental Bureau, Greenpeace, Seas at Risk, the UK Wildlife Trusts, WWF. 12.3.2000, Hamburg

Lauwaert, B. 1998: Overview of Sediment Quality Criteria (SQC) of the North Sea riverine states. Management Unit of the North Sea Mathematical Models (MUMM), Brussels.

LC 1972: London Convention – Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

LC (Scientific Group) (2000): Waste Assessment Guidance: Development of Waste-Specific Guidance – Draft specific guidance of assessment of Dredged Material – Dredged Material Assessment Framework, note by the secretariat for the 23rd Meeting 2000.

Litjes, G. (2000): WWF Helps to Restore the Rhine and Meuse Estuary. In: Workshop Report 'River Sediments and Related Dredged Material as Part of the System Catchment-Coastal Sea: Policy and Regulatory Aspects. W. Salomons, K. Turner (eds.). April 17-19, Marine Safety Institute, Rotterdam. Published by GKSS Research Centre, Geesthacht, Germany.

Matser, E.; Beekman, M. (2000): Dredged Material: Solved in One Generation? Workshop II, April 17-19, Marine Safety Institute, Rotterdam.

OSPARCON (1992): OSPAR Convention – Convention for the Protection of the Marine Environment of the North-East Atlantic.

OSPARCOM (1998 a): Sintra Statement – Ministerial Meeting of the OSPAR Commission on 22-23 July 1998.

OSPARCOM (1998 b): OSPAR Guidelines for the Management of Dredged Material.

OSPARCOM (1998 c): OSPAR Strategy with regard to Hazardous Substances.

OSPARCOM (1999 a): OSPAR Action Plan 1998-2003 (Update 1999).

OSPARCOM (1999 b): Activities of OSPAR July 1998 – June 1999, Implementation of the OSPAR Action Plan 1998 – 2003.

OSPARCOM (2000a): Information from the web site of the OSPAR Commission, 21.3.2000, OSPAR .

OSPARCOM (2000b): Summary Record DYNAMEC 2000. Oslo, 2-4.02.2000. DYNAMEC 00/10/1-E, OSPAR.

OSPARCOM (2000c): Information from the web site of the OSPAR Commission, last updated 08/09/2000, OSPAR Commission.

OSPARCOM (2000d): OSPAR Action Plan 1998-2003 (Update 2000). OSPAR (SEBA) (1999): Techniques Applied by Contracting Parties for Dredging, and their Environmental Effects presented by Germany.

OSPAR (PRAM) (2000): Briefing Document on the Work of DYNAMEC and the DYNAMEC Mechanism for the Selection and Prioritisation of Hazardous Substances.

PIANC (1992): Beneficial Uses of Dredged Material: a Practical Guide. Report of Working Group 19, PTC II (Pfeiffer, Jesse A., jr. et al.). Brussels, Belgium.

PIANC (1997): Dredged Material Management Guide. Special Report of the Permanent Environmental Commission by Tiedo Vellinga, Supplement to Bulletin no. 96. Brussels, Belgium.

PIANC (1998): Management of Aquatic Disposal of Dredged Material. Report of Working Group I of the Permanent Environmental Commission. Brussels, Belgium.

PIANC (2000): Information from the secretariat of PIANC in Brussels, 27.03.2000, Brussels.

SIME (1997): OSPAR/ ICES Workshop on the overall evaluation and update of background/ reference concentrations for nutrients and for contaminants in sea water, biota and sediment – Ostend: 3-7 February 1997.

WWF Germany (2000): Information from the web site, October 10, 2000.

WWF International (2000): Information from the web site, October 10, 2000.

5 Regulations and Experiences from European Harbours

Dredging in harbours has a very long tradition. Besides maintenance dredging, Ports require frequent restructuring and adaptation to the requirements and the necessities of the trade and the developments of vessel traffic. Traditionally the dredged sediments were used beneficially for land development and agriculture.

About 20 years ago the contamination of dredged sediments and the resulting influences on the environment became an issue. This led to a broad political discussion all over Europe, but no consensus was reached. The handling of dredged material has been approached mainly on the national or even regional level.

The following chapters describe the dredged material management of European harbours from the following countries: Germany, The Netherlands, Belgium, Norway, Spain, Sweden, France, Denmark and the UK.

5.1 Germany (Hamburg harbour)

The sediment quality criteria (SQC) represent 'management levels' and are neither ecotoxicological quality criteria nor quality targets. They are only applicable to dredged material from German federal coastal waterways (and not to dredged material from waters under the responsibility of the states (*Länder*) (HABAK-WSV, see chapter 3.3.4). The sediment management in *Hamburg Harbour* will be discussed in more detail in this chapter.

There are 2,000,000 to 3,000,000 m^3 of sediment to be dredged in the Hamburg harbour annually (ARGE Elbe, 1996). Hamburg had to find a solution of relocating the dredged sediments in its limited city borders. The temporal solution consisted and still consists in pre-treatment, i.e. separation into sand and silt and the environmentally safe disposal of the contaminated silt. The sand is used as construction material. The fine sand can be used in the industry as raw material or additive. The silt is used beneficially as a sealing material in the construction of the dredged material disposal sites. It is also used as raw material in brick fabrication. For the disposal of the contaminated silt Hamburg has two silt mounds on its own territory. They have a capacity for 8 or more than 20 years respectively from now. The annual cost of treatment and disposal of dredged material amounts to approximately 45,000,000 DM.

Relocation of dredged material is subject to two main restrictions. The contaminant assessment is based on a recommendation 'Handling of contaminated dredged material at the River Elbe' which was decided by the environmental ministers of the German federal states neighbouring the river. Its base is a (chemical) classification system for different contaminants (table 5-1 after ARGE Elbe, 1996). The levels were developed for the Elbe river by the Federal Environmental Agency (*Umweltbundesamt*) and the ARGE Elbe and are based on the usual water quality assessment in Germany, i.e. they represent management levels and are neither ecotoxicological quality criteria nor quality targets.

Secondly, relocation is only allowed from November to March to protect water quality and fish life.

Table 5-1: Management levels for the assessment of dredged material quality for the Elbe river (ARGE Elbe, 1996)

		Classes						
		I	I-II	II	II-III	III	III-IV	IV
As	mg/kg	3-5	≤ 10	≤ 20	≤ 40	≤ 70	≤ 100	> 100
Pb	mg/kg	25-30	≤ 50	≤ 100	≤ 150	≤ 250	≤ 500	> 500
Cd	mg/kg	0.2-0.4	≤ 0.5	≤ 1.2	≤ 5	≤ 10	≤ 25	> 25
Cr	mg/kg	60-80	≤ 90	≤ 100	≤ 150	≤ 250	≤ 500	> 500
Cu	mg/kg	20-30	≤ 40	≤ 60	≤ 150	≤ 250	≤ 500	> 500
Ni	mg/kg	10-30	≤ 40	≤ 50	≤ 150	≤ 250	≤ 500	> 500
Hg	mg/kg	0.2-0.4	≤ 0.5	≤ 0.8	≤ 5	≤ 10	≤ 25	> 25
Zn	mg/kg	90-110	≤ 150	≤ 200	≤ 500	≤ 1000	≤ 2000	> 2000
PCB 28	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
PCB 52	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
PCB 101	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
PCB 118	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
PCB 138	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
PCB 153	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
PCB 180	µg/kg	-	≤ 2	≤ 5	≤ 10	≤ 25	≤ 50	> 50
α-HCH	µg/kg	-	≤ 5	≤ 10	≤ 20	≤ 50	≤ 100	> 100
γ-HCH	µg/kg	-	≤ 5	≤ 10	≤ 20	≤ 50	≤ 100	> 100
HCB	µg/kg	-	≤ 5	≤ 40	≤ 100	≤ 200	≤ 400	>400
DDT	µg/kg	-	≤ 20	≤ 40	≤ 100	≤ 200	≤ 400	> 400
DDD	µg/kg	-	≤ 20	≤ 40	≤ 100	≤ 200	≤ 400	> 400
DDE	µg/kg	-	≤ 20	≤ 40	≤ 100	≤ 200	≤ 400	> 400
AOX	mg/kg	-	≤ 20	≤ 50	≤ 100	≤ 250	≤ 500	> 500
TBT	µg Sn/kg	-	≤ 10	≤ 25	≤ 75	≤ 150	≤ 250	> 250

Class II is the target level, for class III or II-III an impact assessment shall be made prior to relocation. Dredged material of class IV shall not be relocated. On an average, roughly one third of dredged volumes can be relocated.

For the future the amount of sediments to be dredged should be reduced by means of hydraulic devices like a current deflecting wall. The modestly contaminated sediments will be relocated in the Hamburg part of the river Elbe. The larger amount will be treated on land and beneficially used or relocated to upland confined disposal sites (silt mounds).

There are different guidelines applicable for dredged material at the River Elbe (Netzband, 2000):

- the Elbe guideline (ARGE Elbe)
- the Directive for the Handling of Dredged Material on Federal Inland Waterways of the federal waterways administration (HABAB-WSV, see chapter 3.3.4)
- the Directive for the Handling of Dredged Material on Federal Coastal Waterways of the federal waterways administration (HABAK-WSV)
- the international guidelines issued under the OSPAR (Oslo-Paris) and London Conventions. They are considered as well in the HABAK-WSV.

5.2 The Netherlands

In the Netherlands, and more specifically in the Rotterdam Port area (see also chapter 2), three classification systems for the quality of sediment and dredged material are being used. These classification systems are used for:

- Dredged material disposal;
- General sediment quality and handling guidelines;
- Beneficial use of dredged material.

5.2.1 Classification system for 'dredged material disposal' in the port of Rotterdam

In the Port of Rotterdam, located in the delta of the river Rhine and with an open connection to the North Sea, much dredging has to be done (approximately 20 million m^3/year) to keep the port accessible to ships of all size. Dredged material can contain contaminants that are potentially harmful to aquatic and human life. For Rotterdam a tailor-made classification system was developed to minimise the effects of disposal on the environment (Eisma, 2000).

Material to be disposed of at *sea*: After an analysis of various contaminants and physical parameters, the contaminant levels are recalculated to 'standard soil' values (see appendix 5.3). The parameters needed for a comparison with the maximum levels of contaminants for disposal at sea, as well as these levels themselves are shown in table 5-2. The maximum levels for disposal at sea have since 2000 a national status.

Material to be disposed of in the *slufter* (permanent disposal site): If any contaminant level exceeds the level for disposal at sea (standardised, see above), the dredged material must be disposed of in the slufter.

When the measured contaminant levels exceed the values in table 5-2, the dredged material must be handled as 'hazardous waste', and officially reported as such. For (only) this category no recalculation to standard soil is done.

5.2.2 Classification system for 'sediment quality' in the Netherlands

The system for disposal relies heavily on dredging practice, type of disposal site and behaviour and encountered levels of contaminants. A completely independent classification system was developed based on ecotoxicological criteria and the risks for human and aquatic life of in situ dredged material. In this system various normative levels were established to classify the sediment into five different categories, depending on the (potential) hazard to the environment.

The categories are 'target level', 'limit level', 'test level', 'intervention level' and 'signal value' (see chapter 2).

Limit level: For most contaminants, the limit level represents the so-called maximum acceptable risk for public health and the ecosystem. This level was the goal for the year 2000: contaminant levels in all newly formed sediment should be below this limit level. Dredged material with contaminant concentrations between the target and limit levels is considered to be lightly contaminated and is classified as Class 1.

Table 5-2: Levels for the determination of sediment quality in the Netherlands (Eisma, 2000)

Summary classifications Port of Rotterdam **SUBSTANCE**	Target level	Limit level	Test level	Intervention level	Signal value	Sea-Slufter limit	Haz. waste-value*)
Arsenic	29	55	55	55	150	29	50
Cadmium	0.8	2	7.5	12	30	4	50
Chromium	100	380	380	380	1000	120	5000
Copper	36	36	90	190	400	60	5000
Mercury	0.3	0.5	1.6	10	15	1.2	50
Lead	85	530	530	530	1000	110	5000
Nickel	35	35	45	210	200	45	5000
Zinc	140	480	720	720	2500	365	20000
Naphtalene						0.8	50
Phenanthrene						0.8	50
Anthracene						0.8	50
Fluoranthene (Borneff)						2	
Chrysene						0.8	
Benz(a)anthracene						0.8	
Benzo(a)pyrene (Borneff)						0.8	50
Benzo(k)fluoranthene (Borneff)						0.8	
Indeno(123-cd)pyrene (Borneff)						0.8	
Benzo(ghi)perylene (Borneff)						0.8	
Sum 10 PAHs ("VROM")	1	1	10	40			
Benzo(b)fluoranthene (Borneff)							
Sum 6 PAHs (Borneff)							
PCB-28	0.001	0.004	0.03			0.03	
PCB-52	0.001	0.004	0.03			0.03	
PCB-101	0.004	0.004	0.03			0.03	
PCB-118	0.004	0.004	0.03			0.03	
PCB-138	0.004	0.004	0.03			0.03	
PCB-153	0.004	0.004	0.03			0.03	
PCB-180	0.004	0.004	0.03			0.03	
Sum 7 PCB's	0.02		0.2	1			50
Alpha-HCH	0.003		0.02				
Beta-HCH	0.009		0.02				
Gamma-HCH (lindane)	0.00005	0.001	0.02			0.03	
Sum HCH's	0.01			2			
Hexachlorobutadiene	0.0025	0.02	0.02				5000
Heptachlor	0.0007			4			
Heptachlorepoxide	0.0000002			4		0.02	
Sum Heptachlor + -epoxide		0.02	0.02				
Aldrin	0.00006					0.02	
Dieldrin	0.0005	0.02				0.02	
Sum Aldrin + Dieldrin		0.04	0.04				
Endrin	0.00004	0.04	0.04			0.02	
Sum Aldrin+Dieldrin+Endrin	0.005			4			50
DDT							
DDD						0.02	
DDE						0.02	
Sum DDT + DDD + DDE	0.01	0.01	0.04	4		0.02	50
Hexachlorobenzene	0.00005	0.004	0.02	30		0.02	
Sum pesticides + HCB			0.1				5000
EOX	0.1		7				5000
EOCl	0.1						
Mineral oil	50	1000	3000	5000		1250	50000

These values (all mg/kg d.w.) are taken from the government-document 'Vierde Nota Waterhuishouding' (december 1999).
*) Valid for MEASURED content.

Test level: This is a level set for practical reasons. Fresh water dredged material (i.e. not from the port of Rotterdam, but only from inland waterways) with contaminant levels below the test level may be dispersed in fresh water systems or on land under certain conditions, one of them being that the local (underwater) soil quality should not deteriorate. Sediment with contaminant levels between limit and test level is considered to be mildly contaminated and is defined as Class 2.

Intervention level: When contaminant levels exceeding the intervention level are encountered, there is a case of serious contamination. During dredging for nautical reasons, special measures have to be taken. For other than nautical reasons, further studies must be done to determine the danger for the ecosystem, risk of spreading to groundwater, etc. and eventually the material must be dredged for environmental reasons. No further investigations into the need for environmental dredging are necessary when only the levels of heavy metals exceed the intervention level, but remain below the so-called *signal value* (see table 5-2). The signal value does not define a new class, but exists for practical reasons only. Heavy metals are virtually immobile in undisturbed sediments, so when the levels are not extremely high, not removing the sediment is safer for the environment. When contaminant levels are between test and intervention level, the sediment is moderately contaminated and classified as Class 3. When levels higher than the intervention level are found, the material is Class 4. When dredging (for nautical or environmental reasons) needs to be done with this Class 4 material, special protection measures must be taken by the dredging crew: gloves, coveralls and gas masks must be worn at all times.

5.2.3 Classification system for 'beneficial use' of dredged material (and soil) in the Netherlands

The use of clean or lightly contaminated dredged material in e.g. construction projects reduces the need for clay and sand from fluvial and coastal mining operations. A classification system is developed to determine whether the dredged material is suitable as such, or whether special measures need to be taken. The classification system is described by the 'Dutch Building Materials Decree'.

In order to reuse de-watered dredged material, two aspects of the sediment must be investigated, as the classification system for beneficial use is based on both the amounts and the leachability of the contaminants present. Soil, i.e. de-watered dredged material, with contaminant concentrations below the target level (table 5-3), which is identical to the target level for sediment quality, can be used without any restrictions.

Soil with contaminant levels between target level and limit level (not to be confused with the limit level of the sediment classification system) must be subjected to leaching tests for inorganic parameters. This test is a so-called column test. A soil sample is percolated by acidified water (nitric acid, pH = 4) for 21 days with an up-flow stream in the column and a constant flow velocity. The total amount of percolate must be ten times the weight of the soil sample. The test results are reported as mg contaminant emitted per kg (dry weight) sample.

When the amounts leached are below 'leaching level 1', the soil can be utilised without insulation measures, but only in quantities larger than 10,000 metric tonnes and the material must be removed again when its presence seizes to be necessary (e.g.: soil applied in a road foundation must be removed when the road is abandoned).

When the test results are between 'leaching level 1' and 'leaching level 2', the soil may only be used with specific insulation measures, which will minimise the percolation of rainwater. Again, only quantities larger than 10,000 metric tonnes may be used and the material must be removed again if necessary. Soil with contaminant concentrations higher than the limit level or with leaching amounts higher than leaching level 2 may not be used and have to be disposed of or cleansed.

In this classification system all the levels for amounts of contaminants present are given for standard soil as explained in appendix 5.3.

Table 5-3: Normative levels for beneficial use (maximum allowable concentrations)

	Target level	Limit level
Inorganic substances		
Bromide	20	
Chloride	200	
Cyanide (free)	1	
Cyanide (complex)	5	
Fluoride	175+13L	
Thiocyanate (total)		20
Metals		
As	29	55
Cd	0.8	12
Cr	100	380
Cu	36	190
Hg	0.3	10
Pb	85	530
Ni	35	210
Zn	140	720
Ba	200	625
Co	20	240
Mo	10	200
Organic substances		
Naphtalene		5
Phenantrene		20
Anthracene		10
Fluoranthene		35
Chrysene		10
Benz(a)anthracene		40
Benzo(a)pyrene		10
Benzo(k)fluoranthene		40
Indeno(1,2,3-cd)pyrene		40
Benzo(ghi)perylene		40
Σ 10 PAHs	1	40
Σ 7 PCBs	0.02	0.5
Σ HCHs	0.01	0.5
Heptachlor	0.0025	
Heptachlorepoxide	0.0025	
Σ Aldrin+Dieldrin+Endrin	0.005	0.5
Σ DDT+DDD+DDE	0.01	0.5
Σ pesticides		0.5
TBTO	0.001	
Mineral oil	50	500

All levels in mg/kg dry weight based on standard soil: 10% organic matter and 25% lutite. See appendix 5.3 for recalculation method. Many more substances occur in the official lists. Only these listed above are 'relevant' for dredged material, i.e. occur regularly and are therefore measured on a regular basis.

All relevant (maximum) contaminant levels are given in table 5-2. The leaching levels are given in table 5-4. The amount expected to leach depends on the thickness of the planned construction, which is also taken into account in table 5-4.

Table 5-4: Leachability levels (inorganic contaminants only)

Level 1	I_{max}	0.2 m	0.5 m	0.7 m	1 m	2 m	5 m
Antimony	39	0.1	0.054	0.045	0.039	0.033	0.03
Arsenic	435	1.1	0.91	0.88	0.87	0.84	0.83
Barium	6300	16.7	7.2	5.5	4.2	3	2.3
Cadmium	12	0.059	0.036	0.032	0.029	0.025	0.023
Chromium	1500	4.1	1.7	1.3	0.92	0.58	0.41
Cobalt	300	1	0.51	0.42	0.35	0.28	0.24
Copper	540	1.9	0.9	0.72	0.58	0.43	0.35
Mercury	4.5	0.022	0.019	0.018	0.018	0.017	0.017
Lead	1275	4.6	2.3	1.9	1.6	1.2	1
Molybdenum	150	0.62	0.34	0.28	0.24	0.2	0.18
Nickel	525	2.2	1.3	1.1	0.95	0.8	0.72
Selenium	15	0.077	0.049	0.044	0.039	0.035	0.032
Tin	300	0.85	0.36	0.27	0.2	0.13	0.093
Vanadium	2400	3.5	1.8	1.6	1.4	1.2	1.1
Zinc	2100	8.4	4.5	3.8	3.3	2.7	2.4
Bromide	300	3.5	3	2.9	2.8	2.7	2.7
Chloride	87000	711	616	599	587	572	564
Chloride (use in fresh surface water)	174000	1370	1181	1147	1122	1093	1076
Fluoride	14000	42	18	13	9.6	6.1	4.3
Fluoride (use in brackish or salt water)	56000	162	66	47	34.1	19.7	12.7
Sulphate	100000	1254	1154	1136	1122	1106	1097
Sulphate (use in fresh surface water)	124000	1527	1403	1380	1363	1344	1332
Sulphate (use in brackish or salt water)	180000	2164	1983	1950	1926	1897	1880
Level 2	I_{max}	0.2m	0.5m	0.7m	1m	2m	5m
Antimony	39	0.46	0.43	0.43	0.42	0.42	0.42
Arsenic	435	7.1	7	7	7	7	7
Barium	6300	64	58	58	57	56	56
Cadmium	12	0.083	0.069	0.066	0.065	0.063	0.062
Chromium	1500	14	13	12	12	12	12
Cobalt	300	2.8	2.5	2.5	2.4	2.4	2.4
Copper	540	4.2	3.6	3.5	3.4	3.4	3.3
Mercury	4.5	0.078	0.076	0.076	0.076	0.075	0.075
Lead	1275	10	8.9	8.7	8.5	8.3	8.2
Molybdenum	150	1.1	0.94	0.91	0.89	0.87	0.85
Nickel	525	4.4	3.8	3.7	3.6	3.6	3.5
Selenium	15	0.12	0.1	0.1	0.1	0.1	0.1
Tin	300	2.7	2.4	2.4	2.4	2.3	2.3
Vanadium	2400	33	32	32	32	32	32
Zinc	2100	17	15	15	14	14	14
Bromide	300	4.5	4.2	4.1	4.1	4	4
Chloride	30000	8842	8813	8807	8803	8798	8796
Fluoride	14000	117	104	102	100	98	97
Fluoride (use in brackish or salt water)	56000	465	412	402	395	387	382
Sulphate	45000	22077	22035	22027	2202	22014	22010

I_{max}: maximum input in mg/m^2/100 years, which is the basis for the rest of the table:
0.2, 0.5, 0.7, 1, 2, 5 m: thickness of planned construction with leaching levels (in mg/kg) that may not be exceeded in the column-test.

5.3 Belgium

The SQC represent management levels. They are only applicable to dredged material disposed of to the North Sea. In 1996 an exhaustive study on the establishment of SQC was done; different methodologies, which were applied for obtaining SQC, were investigated and evaluated. The equilibrium partitioning method has been selected.

The following formula is used :

Sediment Quality Criterion (SQC) = partition coefficient * water quality criterion

The *water quality criteria* have been established, based upon ecotoxicity data of the pollutants for marine organisms. In accordance with internationally accepted methods, safety factors were applied, depending on the number of available data. For most pollutants, except for PCBs, two different safety factors were selected, leading to two different water quality criteria. The lower concentration has been selected as target level. The higher concentration has been selected as limit level (see table 5-5).

Based on literature data, as well as on experimental data for different dredged materials in the Belgian coastal zone, *average partition coefficients*, K_d for inorganic pollutants and K_{oc} for organic pollutants, have been deduced (Lauwaert, 1998).

Table 5-5: Levels for the determination of sediment quality in Belgium (from 1998)

	action level 1 (target level)	action level 2 (limit level)
Hg	0.3 ppm*	1.5 ppm
Cd	2.5 ppm	7 ppm
Pb	70 ppm	350 ppm
Zn	160 ppm	500 ppm
Ni	70 ppm	280 ppm
As	20 ppm	100 ppm
Cr	60 ppm	220 ppm
Cu	20 ppm	100 ppm
TBT	3 ppb**	7 ppb
mineral oil	14 mg/g_{oc}	36 mg/g_{oc}
PAHs	70 µg/g_{oc}	180 µg/g_{oc}
PCBs	2 µg/g_{oc}	2 µg/g_{oc}

*ppm - parts per million, **ppb - parts per billion

The following measures can be derived from action levels:

- Disposal of dredged material to sea is prohibited, if the measured value of three substances exceeds the limit level at the same time.
- If the concentration is situated between the target level and the limit level ('grey zone') the number of samples is being increased to the fivefold and new analyses are being carried out. If the concentration in certain parts of the dredged area are still in the grey zone, bioassays should be carried out. Bioassay results showing toxicity can lead to a prohibition of the disposal to sea of dredged material originating from these demarcated areas.

5.4 Norway

The present SQC (sediment criteria for Classification of Environmental Quality and Degree of Pollution) are being tested as managing tools and some adjustments and simplifications are being made to adjust these (general) SQC to dredged material (Lauwaert, 1998).

They are applicable for Norwegian fjords and coastal waters, including harbours.

- SQC have been developed for monitoring purposes, and for establishing the environmental quality of sediments, divided in five classes of quality. These SQC are being modified to be suitable for management of dredging operations and disposal to sea, and are then adjusted to three quality categories: Category 1 (class I & II), Category 2 (class III & IV) and Category 3 (class V).
- The basis for the SQC are knowledge on background levels and documented effects on the marine environment.

The Norwegian SQC are based on analysis of whole sediment samples in the 0-2 cm upper fraction. This is often the most contaminated fraction in Norwegian sediments. Table 5-6 shows the used categories.

Table 5-6: Levels for the determination of sediment quality in Norway (from 1996)

Parameter	Category 1	Category 2	Category 3
Metals (ppm dry weight)			
Arsenic	< 20 - 80	80 - 1,000	> 1,000
Lead	< 30 - 120	120 - 1,500	> 1,500
Fluoride	< 800 - 3,000	3,000 - 20,000	> 20,000
Cadmium	< 0.25 - 1	1 - 10	> 10
Copper	< 35 - 150	150 - 1,500	> 1,500
Mercury	< 0.15 - 0.6	0.6 - 5	> 5
Chromium	< 70 - 300	300 - 5,000	> 5,000
Nickel	< 30 - 130	130 - 1,500	> 1,500
Zinc	< 150 - 700	700 - 10,000	> 10,000
Silver	< 0.3 - 1.3	1.3 - 10	> 10
Organic components (ppb dry weight)			
Σ PAHs [1]	< 300 - 2,000	2,000 - 20,000	> 20,000
B(a)P [2]	< 10 - 50	50 - 500	> 500
Σ PCBs [3]	< 5 - 25	25 - 300	> 300
HCB [4]	< 0.5 - 2.5	2.5 - 50	> 50
EPOCl [5]	< 100 - 500	500 - 15,000	> 15,000
2, 3, 7, 8-TCDDeqv. [6]	< 0.03 - 0.12	0.12 - 1.5	> 1.5

[1] Polycyclic aromatic hydrocarbons (EPA 16)
[2] Benzo(a)pyrene
[3] Polychlorinated biphenyls
[4] Hexachlorobenzene
[5] Extractable persistent organic chlor
[6] Total toxicity potential for polychlorinated dibenzofurans/dioxins, given as equivalents of the most toxic of these components (2, 3, 7, 8-tetrachlordibenzo-p-dioxin).

All applications for dredging are evaluated case by case within each county. There may therefore be some differences in the way dredging operations presently are managed.

All cases are evaluated based on standard procedures for sampling and analysis, using concentrations in sediment as the main criteria. However, results from effect studies or toxicity tests may also be applied.

The main principles of the revised guidelines follow the line of requirements as presented below in table 5-7.

Table 5-7: Dredging and disposal requirements

	Category 1	Category 2	Category 3
Dredging	- No requirements to equipment or monitoring	- Requirements for technical equipment (silt screen, environmentally improved dredging methodology etc.) - Sometimes monitoring requirements	- Requirements for technical equipment (silt screen, environmentally improved dredging methodology etc.) - Monitoring requirements - Sometimes requirements for toxicity testing - Sometimes no dredging allowed at all.
Disposal	- Disposal at designated sites.	- Restricted relocation with requirements for technical equipment. - Site evaluation.	- No relocation, but solutions based on : - capping - CDF - land disposal - treatment

5.5 Spain

Despite the potential environmental risks associated with the removal of contaminated sediments, substantial amounts of dredged sediments are disposed at sea or used as landfill for shoreline modification, wetland restoration, sanitary cover and agricultural soil replenishment. In the Spanish harbours, the average annual volume of material dredged during the period of 1988-1998 was 7,850,000 m^3, and 3,250,000 m^3 was the average annual volume of material disposed into the sea (Belzunce et al., 2000).

There are three basic approaches to manage dredged material, i.e. use of standards (based on total contaminant load), toxicological effects on organisms, or using a case-by-case strategy. The Centro de Estudios y Experimentación de Obras Públicas (CEDEX, 1994) established sediment quality criteria which should allow a classification of sediments in categories associated with different management techniques. They are applicable for Spanish harbours. It is the intention to apply these for the whole country in the next future. More than 95 % of dredged material is already being managed now (Lauwaert, 1998). The quality criteria are based on:

- background levels/load in Spanish coastal sediments
- anthropogenic load in dredged material
- normalisation techniques
- validation of bioassay methodologies
- bioavailability of contaminants

The action levels are shown in table 5-8 (CEDEX, 1994).

Table 5-8: Levels for the determination of sediment quality in Spain (from 1994)

ppm d.w. *	action level 1	action level 2
Hg	0.6	3.0
Cd	1.0	5.0
Pb	120	600
Cu	100	400
Zn	500	3000
Cr	200	1000
As	80	200
Ni	100	400
Σ 7 PCBs**	0.03	0.1
* d.w. = dry weight, **Sum of congeners no. 28, 52, 101, 118, 138, 153, 180		

These concentrations are understood to refer to the silty material of the sediment (diameter lower than 63 µm) and expressed in mg/kg.

The total amount of sediment to be dredged is divided in several parts (usually two or three) that will be managed in different ways. For each of these parts, a weighted mean concentration, C^*, is calculated:

$$C^* = \frac{\sum C_i \cdot p_{F_i} \cdot M_i}{\sum p_{F_i} \cdot M_i}$$

where C_i = the result of the analysis

p_{F_i} = the percentage of fine fraction

M_i = the mass of solids in the volume represented by sample no. '*i*'.

C^* is compared with action levels 1 and 2. Three situations can occur :

- C^* for <u>all</u> parameters are below action level 1 -> *the material is classified as Category I.*

  The chemical and/or biological effects on marine flora and fauna are zero or practically insignificant. The materials dredged belonging to this category can be freely disposed of to sea with the sole consideration of the mechanical effects.

- C^* exceeds for at least one parameter action level 1 and all of them are lower than action level 2 -> *the material is classified as Category II.*

To this category belong dredged materials with moderate concentrations of contaminants. These can be disposed of to sea in a controlled manner (prior selection of the disposal site; the formulation of an impact hypothesis which predicts the physical, chemical and biological effects on the marine environment will be necessary; an environment surveillance programme will be follow to insure that the levels of environmental impact do not surpass those evaluated in the impact hypothesis).

For all the dredged material which can be included within categories I and II, a study must be made on the alternatives for productive uses.

- C^* exceeds for at least one parameter action level 2 -> *the material is classified as Category III.*

  For all category III dredged materials, a study on the advisability of undertaking the disposal on land or in the sea must be done. There are soft isolation ('capping' with clean materials) and hard isolation (impermeable walls) techniques for sea disposal and isolation or treatment techniques for land disposal.

Prior to the above classification, the characterisation of the sediments to be dredged must be done. These studies are based on granulometric analysis, chemical analysis of total organic carbon (TOC), heavy metals (Hg, Cd, Pb, Cu, Zn, Ni, Cr) and organic compounds (PCBs). The biological studies include the estimation of the toxic effect in the short term, the estimation of the toxic effect in the long term to determine sublethal effects, and the estimation of the biological assimilation of harmful substances.

The action levels will be reviewed every two years. Efforts for collaboration with other countries in Europe have been made in the AZTI (Fishing and Food Technological Institute, Spain) through an European proposal, which intents to provide a scientific basis for the consequences of dredging.

5.6 Sweden

The SQC are management tools. They are applicable for dredging operations from marine or maintenance dredging of ports and shipping lanes.

- General remarks :

  (a) dredging material should be regarded as a resource and the possibilities of re-using it should be investigated before any other way of disposal is considered.

  (b) special care should be taken in choosing a way of disposal if the dredged material is contaminated with mercury, PCBs, cadmium or arsenic.

- Quality criteria are based on background levels and/or the volume :

  action level 1: average concentration (C^*) = 3 - 10 * background level and/or having a considerable volume;

  action level 2: average concentration (C^*) > 10 * background level and/or total amount is large.

- This facilitates the classification of dredged material in three cases:

  1st case: $C^* \leq$ action level 1 $\Rightarrow$ uncontaminated sediment

  2nd case: action level 1 < $C^* \leq$ action level 2 $\Rightarrow$ sediment is noticeably contaminated

  3rd case: C^* > action level 2 $\Rightarrow$ sediment is highly contaminated.

SQC are based on background concentrations given in table 5-9.

Table 5-9: Background concentrations of contaminants (after Lauwaert, 1998)

	background level (mg/kg dry weight)
As	10
Pb	10
Fe	40,000
Cd	0.3
Co	15
Cu	20
Cr	20
Hg	0.1
Ni	15
Sn	1
V	20
Zn	125

The following measures are possible, depending on the analysis of sediment samples.

Case 1: Dredged can be disposed of at any suitable site bearing in mind:

- broken rock should not be disposed of to an accumulation bed, but used as a resource
- coarse grained material should be disposed of where the sediment is of similar composition
- fine grained material should be disposed of to an accumulation bed (i.e. where the water content of the top sediment is > 75 %) or on sites with the best possible accumulation characteristics.

Case 2: The dredged material should be disposed of to an accumulation bed.

Case 3: The dredged material should be disposed of in a controllable manner by lagooning or placing it on land.

5.7 France

The SQC are used to determine objectively the quality of the material to be dredged and with a view to decide which way of disposal should be restrained. They are applicable for all French harbours.

One started with the existing results (from the analysis of metals and PCBs) for the different French harbours between 1986 and 1993. These results were plotted on Gaussian-mathematical curves. On the basis of the curve, in which all samples were included, one calculated for each metal the following reference values:

- the value resulting from the extrapolation till 95 % of the rectilinear part of the distribution curve (X_{95})
- the median (M_d)

On the basis of the X_{95} and M_d the following reference values were defined:

- The geological background noise (GBR) for metals = X_{95}-value.
- level 1 = 2 * M_d-value.
- level 2 = 4 * M_d-value.

Special case : PCBs

PCBs are exclusively anthropogenic (=> the geological background noise does not exist). The limit values for level 2 can be calculated by considering that the contamination of dredged material must guarantee the consumption of fish living at the disposal site.

- The acceptable threshold for consumption = 10 mg/kg dry sediment
- Accumulation factor sediment/g organisms = 1
- Correction factor $\beta = 0.1$
- level 2 = 1 mg PCB/kg dry sediment

  or

  0.1 mg of PCB 153, 138

  0.05 mg of PCB 180, 118, 52, 28 per kg dry sediment
- With reference to the metals, level 1 = level 2 divided by 2

Table 5-10: Levels for the determination of sediment quality in France (from 1996)

Metals (mg/kg d.w.)	Background	M_d	level 1 ($2 * M_d$)	level 2 ($4 * M_d$)
Hg	0.2	0.2	0.4	0.8
Cd	0.5	0.6	1.2	2.4
As	4.4	12.5	25	50
Pb	47	50	100	200
Cr	45	45	90	180
Cu	35	22.5	45	90
Zn	115	138	276	552
Ni	20	18.5	37	74

PCBs (mg/kg d.w.)	level 1	level 2
PCB 28	0.025	0.05
PCB 52	0.025	0.05
PCB 118	0.025	0.05
PCB 180	0.025	0.05
PCB 138	0.05	0.10
PCB 153	0.05	0.10

The above shown levels in table 5-10 lead to the following measures:

Case 1: Concentration ≤ level 1 : general permit without specific study.

Case 2: Concentration ≥ level 2: disposal to sea may be prohibited, especially when this disposal does not constitute the least detrimental solution for the environment (particularly with respect to other solutions, in situ or on land).

These levels do not consider the toxic character and the bioavailability of each element. It is the intention to review these levels (especially for Hg, Cd and PCBs) in function of new ecotoxicological data.

Case 3: Level 1 < Concentrations < level 2: a more comprehensive study might be necessary. The content of these studies will be established on a case by case basis in function of the local circumstances and the sensibility of the environment.

5.8 Denmark (Esbjerg harbour)

The port of Esbjerg is connected with the North Sea by the channel of Graadyb. It is a tidal area and the in- and outflow of water take place through Graadyb. During inflow fine suspended material is transported to the harbour basins where it is settling. In 1985 the amount of fine-grained material accumulation in the area has been calculated to be 142,000 tons per year. From this 85 % is derived from the North Sea, 5-6 % from rivers, 4 % from internal coast erosion and another 5-6 % from the combined effect of waste, atmospheric deposition and net primary production. Dredging is necessary in order to maintain the official depths. The yearly dredged quantity is 350,000 - 400,000 m^3. The material is mainly silt (80-90 % below 63 µm) (Norgaard and Clausen, 1994).

Between 1976 and 1989 the material was dredged and disposed of at two disposal sites very close to the port. The material did not settle to the bottom, but was suspended in the water and transported back to the Wadden Sea by the tide.

In 1989 the port of Esbjerg had to get a new permission for the disposal sites (issued from the Ministry of the Environment and the County Administration of Ribe). Before the disposal permission was given samples had to be taken and analysed for heavy metals (Hg, Cu, Zn, Cd, Pb, Ni, Cr; fraction below 63 µm). The results were compared to samples from the Wadden Sea (not affected by the disposal of dredged material) and did not show big difference in most samples (table 5-11). A few samples showed heavy metal concentrations which were 1.5 times the content of heavy metals in the reference background material and this material was not allowed to be disposed. The yearly quantity is about 20,000 - 30,000 m^3. Since 1989 the heavy metals in dredged material have been analysed yearly and have been rather constant.

The effect of disposal operations was studied in a mussel transplantation experiment lasting 5 weeks. The investigations included measurement of mussel growth, heavy metal and total hydrocarbon (mineral oil) content. It was shown that dredged material had a weak growth stimulating effect, but there were no increased concentrations of heavy metals or mineral oil in mussels.

As mentioned before, the yearly quantity of 20,000 to 30,000 m^3 of dredged material has to be disposed of on land. The sediment is pumped into so-called drying-fields, where it settles with a layer thickness of approximately 0.7 metre. It is dried by bottom drainage and surface evaporation. When the sediment is dry enough, i.e. a water content less than 60-80 %, it is finally disposed of in a range of hills (mounds) in a nearby area. The water from drying fields is led to the Wadden Sea. To get a permit for that, ecological/toxicological examinations of the water had to be carried out (*Nitocra spinipes, Phaeodactylum).*

Table 5-11: Heavy metal contents in samples taken at Esbjerg harbour (Norgaard & Clausen, 1994)

	Sample No.													
	Ref. *	disposal level **	1	2	3	4	5	6	7	8	9	10	11	12
Hg	0.30	0.45	0.34	0.35	0.40	0.44	0.33	0.34	0.38	0.35	0.34	0.42	0.32	0.33
Cu	17	25.5	21	20	27	20	22	21	22	35	53	120	25	30
Zn	146	219	170	165	216	165	182	171	267	226	284	321	186	313
Cd	0.42	0.63	0.50	0.47	0.68	0.43	0.50	0.53	0.49	0.64	0.90	0.90	0.52	0.52
Pb	43	64.5	48	48	51	46	57	53	51	54	59	63	57	170
Ni	28	42	32	32	36	33	32	35	25	34	34	38	34	36
Cr	44	66	54	72	54	52	62	53	40	61	57	56	52	58

* Reference or background level ** below this level, disposal at sea is allowed

The available space for land disposal at the port of Esbjerg gives the opportunity to dispose of dredged materials for approximately 15 years (from 1994).

5.9 United Kingdom

The UK analytical system has *no specific sediment quality criteria*; all assessments are case specific using a weight-of-evidence approach. This system is similar to the procedure used in the United States but the individual tiers are not as distinct. With the UK approach, in the above example, other factors would be taken into account and the sample with the value of 99 could be failed, therefore in effect, giving greater protection to the environment. It is also equally true that a value of 101 could pass. The disadvantage of the system from an administrative viewpoint is that experienced, well qualified scientific staff are required to operate the system effectively and it is probable that the decision making process could take longer than with the Action Level system. The weight-of-evidence system is also open to objections, since the decision to grant a licence, or not, is based on informed opinion. However, with good consultation and liaison this should not be a problem and would also serve to educate others about the impacts on the environment. In the UK the majority of material dredged for navigation purposes is disposed of in the marine environment, either in marine disposal sites, or placed for beneficial purposes. The disposal of material at sea is controlled under Part II of the Food and Environment Protection Act, 1985. The Ministry of Agriculture Fisheries and Food, MAFF, is the licensing authority in England and Wales, in Scotland it is the Scottish Executive Rural Affairs Department, SERAD, and in Northern Ireland, the Department of the Environment, DOE(NI).

Table 5-12 provides a summary of the licences granted in 1993-1997, quantities disposed, and the major metal contaminants (all samples were analysed using total digestion in hydrofluoric acid and nitric acid) associated with those disposals (Murray, 2000).

In many ports the method of dredging puts dredged material into suspension rather than removing it. A consequence of this is that the process, through not involving disposal, is outside the MAFF licensing process and is regulated by the Harbour authority.

What is increasingly the case with capital dredging programmes and even large scale maintenance dredging, as for example on the Humber, is that the dredged material is rather regarded as a resource than waste. This is particularly the case with the use of dredged material for beach nourishment.

Table 5-12: Dredged materials licensed and disposed at sea, from UK, 1993-1997

Country	Year	Licences issued	Licensed quantity (Tonnes)	Wet tonnage disposed of	Metal Contaminants (tonnes) Cd	Cr	Cu	Hg	Ni	Pb	Zn
England and Wales	1993	110	66,074,966	26,086,503	7.3	875	606	5.2	458	1,004	2,461
	1994	106	53,187,009	34,049,468	8.0	1,295	734	5.9	587	1,375	3,375
	1995	109	54,300,948	35,215,761	5.8	1,298	625	5.2	548	1,380	3,161
	1996	120	82,395,490	48,516,353	8.8	1,556	744	6.9	673	1,731	3,991
	1997	113	56,536,922	38,627,349	6.5	1,181	573	5.5	470	1,241	2,939
Scotland	1993	26	3,174,050	2,025,525	2.4	50	44	0.8	21	63	132
	1994	23	3,643,250	1,822,053	0.9	42	36	0.5	20	56	122
	1995	32	6,186,600	4,782,421	1.1	155	120	3.5	66	153	349
	1996	30	3,971,045	2,601,864	0.4	56	89	0.7	26	81	155
	1997	29	3,910,900	2,436,745	0.2	23	30	0.3	12	38	94
Northern Ireland	1993	7	996,500	3,392,994	1.8	11	26	1.1	13	23	70
	1994	5	113,200	91,314	0.0	0	0	0.0	0	0	1
	1995	9	335,280	249,593	0.2	2	1	0.1	2	2	8
	1996	6	166,000	135,550	0.0	2	2	0.0	3	2	4
	1997	7	206,000	176,919	0.1	1	1	0.0	1	1	5
UK Total	1993	143	70,245,516	31,505,022	11.5	937	676	7.1	491	1,090	2,663
	1994	134	56,943,459	35,962,835	8.9	1,338	770	6.4	608	1,432	3,498
	1995	150	60,822,828	40,247,775	7.2	1,455	746	8.7	616	1,535	3,518
	1996	156	86,532,535	51,253,767	9.2	1,613	835	7.6	702	1,814	4,149
	1997	149	60,653,822	41,241,013	6.7	1,206	604	5.8	483	1,280	3,037

CEFAS (The Centre for Environment, Fisheries & Aquaculture Science) follows the guidelines set out by the OSPAR Commission for the management of dredged material. These guidelines recommend the methodology for sampling and list the contaminants to be measured in the sediment prior to dredging and sea disposal. Licence applicants are required to submit samples for chemical analysis at the CEFAS laboratories. Data for the levels of a number of contaminants in dredged material have been compiled over several years.

The majority of sediments analysed by CEFAS and assessed for sea disposal are judged to be acceptably low in contaminants for sea disposal to be permitted in appropriate disposal sites, and subject to particular conditions. Some 10 % of the applications from England and Wales are assessed by CEFAS to be too highly contaminated by TBT or other contaminant to be acceptable for sea disposal. For the majority of these dredged areas, licences are issued for some of the dredged material, with the specific exclusion of material from the contaminated areas. A small number (1-2 %) of licence applications for sea disposal are refused each year, outright based on the contaminant content of the dredged material. This dredged materials requires alternative land-based solutions for its disposal or treatment.

The assessment of TBT concentrations in dredged material follows guidelines set out by OSPAR. The assessment considers the nature of the material, the quantity to be disposed to sea, and other physical and chemical analyses. The characteristics of the disposal site are also taken into account in the assessment.

The majority of dredged material analysed for TBT contained <0.1 mg kg^{-1} and was considered to be acceptable for disposal to sea.

While the metals listed in table 5-12 have been measured in sediments at disposal sites for several years, it is only recently that TBT has been measured in sediments from a few selected disposal sites.

The need for biological testing protocols was recognised in the UK some years ago, and MAFF has funded development work in this area. CEFAS has applied the battery of biological tests it has developed for use on sediments to a large number of dredged material samples, together with corresponding chemical analyses. The requirement now is for development of this work into a practical application that can be used to substantiate disposal licence assessments. Work is now underway to develop these existing protocols into a risk assessment procedure for use in licence assessments, and to develop further protocols for chronic tests and bio-accumulation tests that will be capable of incorporation into the procedures.

5.10 European harbours in comparison

Regulations and guidelines for the assessment of the quality of dredged material as well as the decision-making frameworks for the disposal of dredged material are not harmonised among the countries discussed in the previous chapters. Even on the national level different classification systems and criteria for disposal exist, e.g. federal waterways, Hamburg Harbour etc. in Germany. Because of different standardisation methods quality criteria of different countries are not comparable. For that reason there is no summarised overview of all levels in one table presented.

Chemical criteria for the assessment of the quality of dredged material generally are based on ecotoxicological evaluations, however action levels for permits for marine disposal usually are influenced by political and/or economical decisions. Moreover there are examples were guidance levels for disposal have been established which are not legally binding and permits for disposal are up to decisions on expert knowledge.

All discussed countries are contracting parties of the OSPAR convention, but with regard to the OSPAR ‘dredging guideline’, no country fulfils all required chemical and biological characterisation methods (chapters 5.4 - 5.9).

It can be concluded that there is a general lack of harmonisation resulting in more or less stringent and legally binding or not legally binding regulations for the management of dredged material in European harbours. This has with regard to the competition among e.g. European sea ports the undesirable effect that economic burdens due to the handling of dredged material might differ according to more or less stringent individual regulations.

The chemicals analysed and limit levels chosen for determination of *sediment quality* differ from harbour to harbour. All ports investigate heavy metals (Cd, Cr, Cu, Hg, Ni, Pb, Zn) and As. Concerning inorganic contaminants the countries Norway (F, Ag) and Sweden (Fe, Co, Sn, V) apply additional criteria for other metals as well. The Netherlands evaluate additional elements (e.g. Ba, Co, Mo, Sb, Se, Sn, V) when they want to use the dredged material in a *beneficial* way. The limit levels differ from country to country. Belgium and The Netherlands have the most stringent ones and Spain the less stringent for heavy metals. The UK doesn't even have any strict limit levels for contaminants. They use the so-called weight-of-evidence approach.

Concerning organic contaminants, there seem to be bigger differences between harbours. Rotterdam harbour has got the most extensive list of organic chemicals, but TBT, one of the most toxic substances, is only analysed when beneficial use of dredged material is the objective. Only Belgium, Hamburg harbour and the UK have TBT on their sediment quality list. Denmark, especially Esbjerg harbour, seem not to have big problems with organics (except mineral oil), presumably because of high portion of marine sediment (~ 85 %) and lower input from rivers, coast erosion and atmospheric deposition.

The use of bioassays as additional criteria is an important aspect. At present, only Esbjerg has to conduct biotests to get a permission for discharging drainage water from dredged material (pre-treatment before land disposal) into the Wadden Sea. In other countries a discussion on the implementing of bioassays into sediment quality assessment has started. In the Netherlands currently a battery of tests for acute toxicity is already under evaluation and the implementation is planned for 2002.

References

ARGE Elbe (1996): Umgang mit belastetem Baggergut an der Elbe - Zustand und Empfehlungen. (in German)

Belzunce, M.J. (2000): The problematic of contaminated sediments: a general view of the situation in Spain. AZTI, Fishing and Food Technological Institute. 3 pp. (not published)

CEDEX (1994): Recommendations for the management of dredged material in the ports of Spain. Informes puertos del Estado. 45 pp.

CEFAS (1998): Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1995 and 1996. Sci. Ser., Aquat. Environ. Monit. Rep., Lowestoft, 51, 116 pp.

Eisma, M. (2000): Classification systems for sediment quality and dredged material handling, disposal and beneficial use in the Netherlands. Port of Rotterdam. 15 pp.

Lauwaert, B. (1998): Sediment Quality Criteria (SQC) - Overview of the North Sea riverine states. Oslo and Paris convention for the prevention of marine pollution working group on sea-based activities (SEBA). 18 pp.

Murray, L. (2000): Regulation of marine dredged material disposal in the UK, future approaches and implications for source control. GKSS Workshop, Rotterdam. 5 pp.

Netzband, A. (2000): Dredged material treatment in Hamburg - Concept and future development. Strom- und Hafenbau, Ingenieurbüro Baggergut. 4 pp.

Norgaard, H., Clausen, E. (1994): Port of Esbjerg, A port on the Danish Wadden Sea - Solutions to environmental problems concerning maintenance dredging. Proc. of the PIANC Congress in Sevilla, Spain.13-20.

6 Summary and Conclusions

As summarised in figure 6-1, the national, Dutch and German, European and international regulations concerning the immission and emission approach and dredged material management build a complex system of interactions.

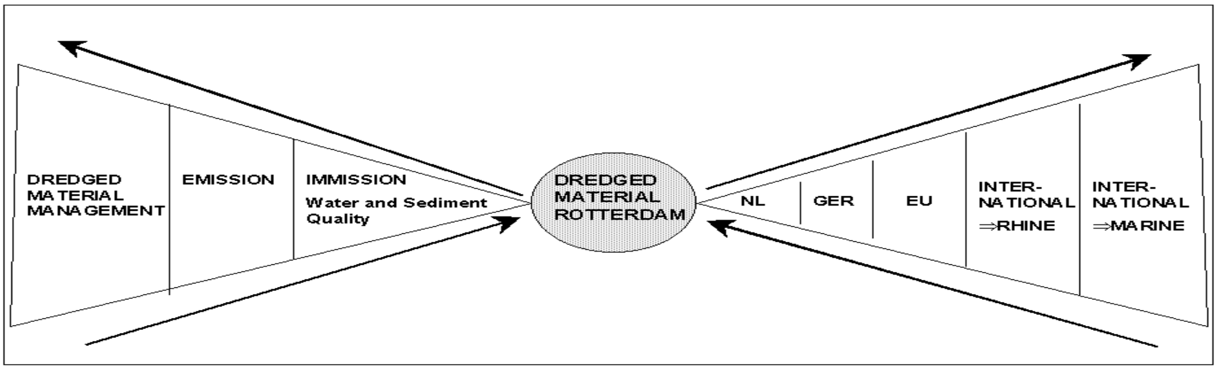


Figure 6-1: Overview over the interactions of national and international regulations

Countries like the Netherlands and Germany are member states of the European Union as well contracting parties of the International Commission for the Protection of the Rhine (ICPR, Rhine catchment area) and conventions as the Oslo and Paris Convention (OSPARCON) concerning the receiving coastal environment (North Sea). They therefore are directly involved in setting up guidelines and regulatory frameworks on the EU and international level which then have an impact on the national policies and regulatory frameworks.

On the different levels there are three major aspects. Emission control and the immission approach (quality targets) have a direct impact on the quality of sediments in the Rhine catchment area including the Port of Rotterdam whereas guidelines for dredged material management on the international level (e.g. OSPARCON) set up a framework and give recommendations for the implementation of regulations concerning dredged material management on the national level.

These intricate and complex issues at the national, European and international levels were analysed in detail in the preceding chapters. In the following the findings are summarised under the following headings:

1. Sediment quality targets
2. National emission targets
3. International agreements for dredged material
4. Feedback between dredged material quality and emission control
5. Dutch and German regulations for dredged material
6. Dutch and German regulations as part of international agreements/guidelines
7. Future policy trends for sediment quality, emission control and dredged material management
8. Outlook for research and management

1. Sediment quality targets

At present, on an international level (EU, OSPARCON) neither uniform marine nor freshwater sediment quality targets do exist. Within the scope of the new European Water Framework Directive (EC-WFD) uniform quality targets shall be defined for rivers and coastal waters, which are expected to serve as minimum requirements for the implementation of national quality targets. In contrast to the EC-WFD, OSPARCON does not intend to define uniform quality targets concerning the North-East Atlantic (incl. North Sea) as regional aspects should be taken into account.

Both, the Netherlands and Germany have established national sediment quality targets. In addition to these national quality targets, river basin specific quality targets have been set (e.g. ICPR for the Rhine, International Commission for the Protection of the Elbe (IKSE) for the Elbe). However in the case of the Rhine, the ICPR only defined water quality targets, with one exception: quality targets for metals concerning suspended particulate matter.

The Netherlands have established two sets of sediment quality objectives for metals and organic substances, which are valid for both marine and freshwater sediments and which are based on ecotoxicological assessment and political decisions (environmental yield/costs ratio): the target level (long-term objective) and the limit level (short-term objective). In a long-term perspective a harmonisation of inland and marine quality targets is anticipated. The improvement of surface water quality aims as well at the unrestricted marine disposal of estuarine dredged material.

In Germany there are no marine sediment quality targets yet, but national freshwater sediment quality targets for seven metals currently do exist (German federal working group on quality targets, BLAK QZ). These sediment quality targets are based on ecotoxicological assessments. In addition, in the framework of ICPR water quality targets for polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) are stated.

A comparison of the Dutch and German sediment quality targets for metals, lead, cadmium, chromium, copper, nickel, mercury and zinc shows, that in most of the cases the Dutch long-term sediment quality targets are more stringent than the German ones. Only in the case of chromium it is the same value. On the other hand the Dutch short-term sediment quality targets are in most cases less stringent than the German quality targets.

Referring to the discussed complex situation of quality targets the demand for transboundary river basin management including the receiving marine environment calls for uniform quality targets at the individual river basin and its associated coastal zone level.

2. National emission reduction targets

Emission reduction targets at the international level are determined in the framework of the International Conferences for the Protection of the North Sea (ICPNS) and in the framework of the OSPAR Convention as well as in the ICPR.

The Netherlands have stated additional national emission reduction targets for metals, tributyltin (TBT) and polycyclic aromatic hydrocarbons (PAHs) until 1995. The most successful reduction was achieved for cadmium, with a realisation of the target of 91 %. The target for PAHs was only realised to 16 %.

To our knowledge Germany has not defined national reduction targets in addition to the commitments on the international level. That might be explained by the German approach that the maximum possible reduction of emissions should be gained by using Best Available Technique (BAT) for point sources and Best Environmental Practice (BEP) concerning diffuse sources. In recent years reduction measures concerning emissions (to water) of point sources in the Rhine catchment area have been quite successful, resulting in a shift from point sources towards diffuse sources. To achieve further reduction it will be necessary to control diffuse sources.

3. International agreements for dredged material

The worldwide acting Permanent International Navigation Association (PIANC) is one of, if not, the oldest organisation dealing with providing information about ports management in a changing environment. Since the foundation of PIANC many other organisations and conventions concerned with enhancing or sustaining the quality of the marine and fluvial environment have come into force. With regard to the management of dredged material in the North Sea the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPARCON 1992), the International Conferences on the Protection of the North Sea (ICPNS) and the London Convention (LC 1972) are the most important agreements. The International Maritime Organisation's (IMO) main task is maritime safety and efficiency of navigation but it partly influences dredged material quality, e.g. by the pending IMO ban on tributyltin (TBT) as antifouling agent in ship paints. Other organisations, such as the International Council for the Exploration of the Sea (ICES) and the Central Dredging Association (CEDA), provide scientific and technical support for the management of dredged material. They have an observer status in the international conventions.

Agreements of IMO, LC, OSPARCON (agreements and decisions) and HELCON are binding due to international law. Major outcomes are recommendations and guidelines that in general include more detailed requirements but are not binding in law. This applies also to the declarations of the International Conference on the Protection of the North Sea (ICPNS) and the requirements and guidelines of the International Commission of the Protection of the River Rhine (ICPR). The national regulations (e.g. classification schemes, action levels) for dredged material are allowed to vary widely among the contracting parties of every convention. This makes it possible to take differing regional aspects into account. However there is a demand for further harmonisation of the overall approaches for the assessment of sediment quality, hazard assessment and risk assessment in the scope of dredged material management.

OSPARCON has due to its nature of the contracting parties in comparison to the LC a greater impact on marine protection policies in the North Sea; its requirements/recommendations are more extensive. While the LC, which has a world-wide obligation, focuses mainly on dumping of wastes and matters in the marine environment, OSPAR considers land-based emissions as well.

The activities of the International Commission of the Protection of the River Rhine (ICPR), since its foundation in 1950, had a successful impact on the water quality of the River Rhine. Nevertheless the concentrations of some contaminants in the sediments of the upper Rhine still exceed the Dutch thresholds for the disposal of dredged material into the North Sea. In the year

2005 the program 'Sustainable Development of the River Rhine' will be implemented that includes a further improvement of water and sediment quality.

In September 2000 the European Water Framework Directive (EU-WFD) was adopted by the European Parliament and Council. The EU-WFD shall substitute various EC-Directives concerning water quality and shall harmonise water management within Europe. The requirements of the EU-WFD are legally binding. The management of dredged material is not covered in this framework. However, the emission targets for hazardous substances and the river basin management plans could improve the water quality and also after a certain time lag the quality of sediments. Therefore, the framework will influence indirectly the management of dredged material.

4. Feedback between dredged material quality and emission control

The international conventions for the protection of the marine environment state in their dredged material management guidelines that high priority should be given to the identification of sources as well as the reduction and prevention of further contamination of sediments. Furthermore, both point and diffuse sources should be addressed adequately.

The Netherlands follow the principle that the quality of the dredged material to be disposed at sea should be improved by reducing inputs of contaminants in rivers and estuaries. These emission reductions should be achieved by the application of Best Available Techniques. The Dutch emission measures address both point and diffuse sources, with a current emphasis on the latter. Dredged material quality is not yet used in a feedback system to emission control, but it has been advised to implement such an effect-oriented emission approach. On the other hand, private initiatives to reduce emissions in the River Rhine by the Port of Rotterdam authorities have proven to be successful.

It is not obvious, whether Germany has a feedback system from dredged material quality to source control as required internationally. The environmental objective of different German environmental laws include sediments as a compartment of nature. The emission principle (with its emission standards) is the main tool in German environmental law, e.g. for wastewater discharges to surface water the Best Available Technique is required to fulfil the environmental objectives. To assess whether the Best Available Technique is applied, a wastewater (whole effluent) assessment is carried out by using bioassays. But at present the effects of effluents on organisms living in sediments (benthos) are not considered.

Two indirect pathways of sediment pollution are air and soil pollution. The protection or enhancement of air and soil quality are environmental objectives in German law (Federal Immission Control Act and Federal Soil Protection Act), but the accumulation of pollutants in sediments is not taken into account. During the last 25 years the emission thresholds of the Immission Control Act became more and more stringent. As a result, the air quality in Germany improved and for example the heavy metal emissions have decreased significantly over time. Soil protection including measures to reduce erosion intend to prevent the entry of contaminants in fluvial systems and the leaching into groundwater that often ends up in surface waters.

Another aspect which makes a feedback mechanism from dredged material contamination to source control difficult: Dredged material management and source control are subjects of different authorities in Germany. While on a national level the Federal Ministry of Transport and its subordinated authorities are responsible for dredged material management, source control is in the competence of the Federal Ministry for Environment, Nature Conservation and Nuclear Safety.

5. Dutch and German regulations for dredged material

A comparison of Dutch and German regulations are of interest because of two aspects: Both countries dispose dredged material in the North Sea, but even more so the dredged material management (e.g. relocation of sediments from weirs and locks in the upper Rhine and its tributaries) in the German part of the Rhine influences the quality of downstream sediments and hence the quality of dredged material in the port of Rotterdam.

German regulations concerning dredged material management are complex and a nation-wide regulation for the handling of dredged material is missing. This is caused by the federal structure of Germany and therefore its federal and state (*Länder*) directives. In addition, depending on the degree of contamination, different regulations have to be considered. Uncontaminated dredged material can be treated as a resource, but contaminated dredged material has to be treated as waste. The different federal and state regulations state different action levels, which consequently lead to different evaluations and decisions in handling contaminated dredged material. Both, federal and *Länder* representatives stress the need for harmonisation.

Two main differences are found between the current Dutch regulation concerning the dredged material management and the German regulations for Federal waterways.

The Netherlands established five levels of sediment quality criteria, which are based on ecotoxicological assessment and political decisions. Coupled to these levels there is a sediment classification system on which the decision about the inland disposal option is based; the lowest 3 classes of sediment (below the testing value) can be disposed in surface water or on land, whereas the highest two classes should be treated or stored. In addition to this, there are the so-called Uniform Quality Criteria as (chemical) decision criteria for the marine disposal of estuarine dredged material. The use of bioassays in the assessment of estuarine dredged material quality is foreseen for 2002.

In Germany two action levels are stated for dredged material management in Federal coastal waterways. They are derived from the prevailing contaminant concentrations measured in North Sea sediments from 1982 – 1992. Ecotoxicological and biochemical data support decision-making, but in general only one bioassay is used for that purpose. The action levels are not environmental quality targets or objectives, but guide values. The decision is generally guided by the values, but is made on a case-by-case basis. For Federal inland waterways the disposal decision is based on chemical and ecotoxicological criteria (applying a bioassay test-set). The criterion for the disposal decision is that a deterioration of water and sediment quality at the disposal site is not allowed. The decision is, like for Federal coastal waterways made on a case-by-case basis.

6. Dutch and German regulations as part of international agreements/guidelines

In the framework of the Oslo and Paris Convention (OSPARCON), the London Convention (LC), the Helsinki Convention (HELCON), the Permanent International Association of Navigation Congresses (PIANC), the International Association of Dredging Companies (IADC) and the Central Dredging Association (CEDA) several international dredged material management guidelines have been issued.

Both, the Dutch and German dredged material management regulations follow the mainstream of the international guidelines. It has to be pointed out, that the international guidelines require the establishment of action levels. The international guidelines do not state any quantitative environmental quality target or objective, this is in the responsibility of the nations themselves.

As mentioned before, the Netherlands and Germany have established action levels in different ways. The international guidelines concerning dredged material require the use of bioassays to assess the ecotoxicological effects of dredged material. They provide a unique tool to measure bioavailability and they integrate the effects of (all) compounds in the sediment, including those, which are not covered by chemical analysis. Therefore, the guidelines require in a tiered approach, after physical and chemical characterisation the application of a test-set of bioassays.

According to the international guidelines the following aspects should be covered by the ecotoxicity tests:

- acute toxicity;
- chronic toxicity such as long-term sub-lethal effects, covering an entire life cycle;
- the potential for bioaccumulation;
- the potential for tainting.

In addition, one guideline requires that genotoxicity and mutagenicity should be tested (PIANC 1998).

The OSPARCOM Guideline (1998) recommends the following biological test methods: toxicity bioassays, biomarkers, microcosm experiments, mesocosm experiment, field observation of benthic communities and other methods to determine e.g. the potential for bioaccumulation and for tainting.

The current Dutch dredged material management does not fulfil these requirements, but in 2002 an integrated assessment system for dredged material should be available, based upon biological effect measurements and the environmental chemical burden. At present a test-set of four bioassays (mainly addressing acute toxicity) is validated and shall be implemented in 2002.

The current German biological characterisation of marine dredged material includes (in general) the application of one bioassay. But in Germany efforts are underway for the validation, harmonisation and implementation of a marine bioassay test-set to evaluate marine water and sediment samples. Therefore in the near future the possibility for the implementation of marine bioassays exists. For freshwater sediments several bioassays are already applied.

7. Future policy trends for sediment quality, emission control and dredged material management

The future developments will be dominated by two main items:

- the Sintra Statement, which was proclaimed at the Ministerial Meeting of the OSPAR Commission and which confirmed the Esbjerg Declaration of the ICPNS on hazardous substances;
- the European Water Framework Directive.

In the Sintra Statement the objective is stated to prevent pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous substances (i.e., substances which are toxic, persistent and liable to bioaccumulate or which give rise to an equivalent level of concern), with the ultimate aim of achieving concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. The Ministers stated further that the Contracting Parties shall make every endeavour to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020.

At present the OSPAR Commission works on a prioritisation of substances of concern. After establishing a priority list, further reduction targets by applying the Best Available Technique and the Best Environmental Practice will be developed.

Within the EU-WFD, the member states shall aim to achieve the objectives of preventing deterioration of ecological status and pollution of surface waters. They further shall aim to achieve a restoration of surface waters, with the objective of a good surface water status or, for water bodies designated by the member states as 'heavily modified' or 'artificial' water bodies, a good ecological potential and a good surface water chemical status. These objectives shall be realised at the latest 16 years after the date of entry into force of this directive.

To achieve these objectives a combined - i.e. emission and immission - approach for point and diffuse sources is constituted. As a central tool of the EU-WFD, 'programmes of measures' and 'river basin management plans' are required. Both shall be created until 2010.

The strategies against the pollution of water include a priority list of 32 substances, for which the Commission shall submit proposals for controls of the principle sources of the emissions concerned. In doing so it shall take into account both point and diffuse sources and shall identify the cost-effective and proportionate level as well as the combination of product controls and emission values for process controls.

The Commission shall also submit proposals for quality standards applicable to the concentrations of the priority substances in surface water, sediments and biota. The procedure for the setting of chemical quality standards by member states shall contain the application of acute and chronic bioassays.

The future developments concerning the environmental objective will depend on how many surface waters will be defined by the member states as 'heavily modified'. The designation of water bodies as 'heavily modified' would result in a less stringent water quality control.

Concerning the emission principle, the EU-WFD refers to other directives, such as the IPPC Directive (Integrated Pollution Prevention Control). In the framework of the EU-WFD emission standards will mainly be established for hazardous substances. Therefore, future developments concerning emission control and subsequently sediment (and dredged material) quality will depend on the quality of emission standards and sediment quality criteria.

According to the Dutch project group for the implementation of the EU-WFD, the Dutch emissions policy with emphasis on the precautionary principle, life-cycle management and the system of risk assessment fits in well with the Directive, and so is the combined approach of discharges via point sources and diffuse sources. In some aspects, however, the Directive seems to be less stringent than Dutch policy. During the 1995 North Sea Ministers Conference in Esbjerg, the Netherlands have committed themselves to the total ban of all dangerous substances from water within 25 years. The European Directive is more moderate in its aim of 'progressive reduction of emissions of dangerous substances'. The project group concludes that such a difference should be settled in the final river basin management plans, in order to prevent legal inequality with respect to permit and product policy. Furthermore, it should be established, whether as a result of the EU-WFD, the coastal zone border is shifting that far into the sea that it has consequences for existing agreements on marine dredged material. By the implementation of a more sea-bound coastal zone, this activity could fall under the jurisdiction of the European Directive, instead of the OSPAR Convention.

8. Outlook for research and management

- Existing regulations show an urgent need for harmonisation of sediment quality targets/criteria in river catchments and those for the disposal of river sediments in the receiving marine environment. The river catchment and the coastal zone should be treated as a continuum/one system.
- Emission control is essential in further improving sediment and dredged material quality. The EU-WFD follows a combined approach of emission and immission control with emphasis on the latter. With this respect, the designation of water bodies (rivers) as 'heavily modified' is of importance as it might result in less stringent water quality control and consequently contaminated sediments. From a dredged material management point of view and for the protection of the coastal zone (the receiving environment), this classification should be interpreted carefully.
- The feedback mechanism between sediment quality and emission control is not sufficiently established and needs improvement. Important stakeholders in this respect are port authorities. A mechanism might be to strengthen the position of stakeholders in the relevant commissions and working groups.
- Regulations and guidelines at the EU-level directly addressing the dredged material issue are missing. This is surprising in view of the volumes of sediments dredged and the costs involved. Representatives of the different stakeholders dealing with dredged material should set common objectives to improve the awareness concerning contaminated sediments and to harmonise regulations concerning the management of dredged material especially between coastal and freshwater zones and within Europe.
- Bioassays are increasingly recognised as a suitable tool for determining sediment quality – in addition to chemical criteria – and are recommended to be applied e.g. by the OSPAR Convention. However, there is further research demand in order to implement the

application of bioassays successfully. Mayor issues according to the science-oriented workshop, organised as part of this project, are:

- the interpretation of results from bioassays with regard to their applicability towards decision-making frameworks for dredged material management,
- the development, standardisation and evaluation of bioassays, especially for chronic toxicity, receptor-based assays / biomarkers.

List of abbreviations

AbwAG	Abwasserabgabengesetz, Waste Water Charges Act
AbwV	Abwasserverordnung, Ordinance of Waste Water
ACFM	Advisory Committee on Fishery Management
ASMO	Environment Assessment and Monitoring Committee (part of OSPAR)
BfG	Bundesanstalt für Gewässerkunde, Federal Institute of Hydrology
BGBl	Bundesgesetzblatt
BLAK QZ	Federal/Länder Working Group on quality targets Bund-/Länder-Arbeitskreis 'Qualitätsziele'
BImSchG	Bundes-Immissionsschutzgesetz, Federal Immission Control Act
BBodSchG	Bundes-Bodenschutzgesetz, Federal Soil Protection Act
DMG	Law of Fertiliser (Düngemittelgesetz)
GefStoffV	Ordinance of Hazardous Substances (Gefahrstoffverordnung)
C^*	mean concentration, ppb or ppm
C	concentration, ppb or ppm
C_{pw}	chemical concentration in the pore water, mg chemical / L
C_S	mg of substance / kg soil or sediment
CEDA	Central Dredging Association
CEDEX	Centro de Estudios y Experimentación de Obras Públicas, Spain
CEFAS	Center for Environment, Fisheries & Aquaculture Science, UK
CEMP	Coordinated Environmental Monitoring Programme
ChemG	Chemikaliengesetz, Chemicals Act
ChemVerbotsV	Chemikalienverbotsverordnung, Ordinance of Prohibitions and Restrictions of Circulation of Hazardous Chemicals
CONSSO	Committee of North Sea Senior Officials
Cu	Copper
DMAF	Dredged Material Assessment Framework
DTF	Dredging Task Force
d.w.	dry weight
EC	European Community
EU	European Union
EC-WFD	European Water Framework Directive
ENW	Evaluatie nota Water, Water Policy Evaluation Document

ETC/MC	EEA-European Topic Centre on Marine and Coastal Environment
FAO	Food and Agriculture Organization of the United Nations
f_{OC}	mass fraction of organic carbon in the solid
GHR	Gemeentelijk Havenbedrijf Rotterdam, Rotterdam Municipal Port Management (RMPM)
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities
HELCON	Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention)
HOI	Haven Ontvangst Installatie, harbour collection installation
IADC	International Association of Dredging Companies
IAPH	International Association of Ports and Harbours
ICES	International Council for the Exploration of the Sea
ICPR	International Commission for the Protection of the Rhine
IMO	International Maritime Organization
IPO	Interprovinciaal overleg, Association of Provinces
IPPC	Integrated Pollution Prevention and Control
JAMP	Joint Assessment and Monitoring Programme
K_d	Solid / water distribution coefficient $K_d = \frac{C_S}{C_{pw}} \qquad \frac{mg\_chemical/kg\_solid}{mg\_chemical/L\_water}$
K_{OC}	Partition coefficient to describe the distribution of organic chemicals between soil pore water and soil organic matter $K_{OC} = \frac{K_d}{f_{OC}}$
KrW-/AbfG	Kreislaufwirtschafts- und Abfallgesetz, Cycle Management and Waste Act
LC	London Convention
M_d	median value
MEPC	Marine Environment Protection Committee
M_i	solid mass
MPR	Maximum Permissible Risk, Maximum Toelaatbaar Risico (MTR)
MSC	Maritime Safety Committee
NAP	North Sea Action Plan
NGO	Non Governmental Organisation

NMP	Nationaal Milieubeleidsplan, National Environmental Policy Plan
NR	Negligible Risk (NR), Verwaarloosbaar Risico (VR)
NW3	Derde Nota waterhuishouding, Third Policy Document on Water Management
NW4	Vierde Nota waterhuishouding, Fourth Policy Document on Water Management
OCP	Organo Chloro Pesticides
OSPAR(CON)	Convention for the Protection of the Marine Environment of the North-East Atlantic (Oslo and Paris Convention)
OSPARCOM	Oslo and Paris Commission
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
p_{Fi}	percentage of fine fraction
PflSchG	Pflanzenschutzgesetz, Plant Protection Act
PIANC	Permanent International Navigation Association
ppm	parts per million, e.g. mg/kg
ppb	parts per billion, e.g. µg/kg
PRAM	Programs and Measures Committee (part of OSPAR)
RAP	Rhine Action Plan
RIKZ	Rijksinstituut voor Kust en Zee, National Institute for Coastal and Marine Management
RIZA	Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling, Institute for Inland Water Management and Waste Water Treatment
RWS	Rijkswaterstaat, Directorate General for Public Works and Water Management
SOLAS	Safety of Life at Sea
SOP	Standard Operation Procedure
SQC	sediment quality criteria
TBT	tributyltin
TEA	Total Effluent Assessment
TIE	Toxicity Identity Evaluation
TrinkwV	Trinkwasserverordnung, Drinking Water Ordinance
UBA	Umweltbundesamt, Federal Environmental Agency

UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UN-ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UQC	Uniform Quality Criteria, Uniforme Gehalte Toets (UGT)
US-EPA	United States – Environmental Protection Agency
UvW	Unie van Waterschappen, Association of Water Boards
VNG	Vereniging van Nederlandse gemeenten, Association of Municipalities
V&W	Ministerie van Verkeer en Waterstaat, Ministry of Transport, Public Works and Water Management
VROM	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, Ministry of Housing, Spatial Planning and the Environment
Wbb	Wet bodembescherming, Soil Protection Act
WFD	European Water Framework Directive
WHG	Wasserhaushaltsgesetz, Water Management Act
Wm	Wet Milieubeheer, Environmental Protection Act
WODA	World Organisation of Dredging Associations
Wvo	Wet Verontreiniging Oppervlaktewateren, Pollution of Surface Water Act
Wvvs	Wet Voorkoming Verontreiniging door Schepen, Act on the Prevention of Pollution by Ships
Wvz	Wet Verontreiniging Zeewater, Seawater Pollution Act
X_{95}	value resulting from the extrapolation till 95% of the rectilinear part of the distribution curve
Zn	Zinc