National Action Plan for Malta
for the Reduction and Elimination of Land Based Pollution

(In the framework of the implementation of the Strategic Action Programme to address pollution from land-based activities)

Baseline Budget
of Emissions/Releases for SAP targeted pollutants for Malta,

2003

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As submitted to

The United Nations Environment Programme,

Coordinating Unit for the Mediterranean Action Plan

Through

The Environment Protection Directorate of the

Malta Environment and Planning Authority.

CONTENTS

1. Introduction

1.1 Background

Within the framework of the implementation of the Strategic action Plan Programme (SAP) adopted by the 12th Meeting of the Contracting Parties to the Barcelona Convention, Mata is expected to prepare a national Baseline Budget (BB) of emissions/releases for the SAP targeted pollutants covering all the substantial land-based sources. This BB together with a National Diagnostic Analysis (NDA) should form the starting point for the eventual formulation and implementation of a National Action Plan (NAP) for Malta for the reduction and elimination of land-based pollution.

The introduction of a national BB within the NAP and SAP operational strategy will enable the competent authorities to assess in an objective manner the degree of progress achieved as a result of the implementation of the NAP towards achieving stated quantitative targets in the reduction of specific pollutants or classes of pollutants.

The adopted general targets of the SAP are as follows:

> By 2010, to reduce by 50% releases of substances that are toxic, persistent and liable to bio accumulate (TPB substances) from industrial installations. Releases into the marine environment as well as into the atmosphere are to be included.
>
> By 2010, to reduce by 50% releases of polluting substances (in addition to TPB substances) from industrial installations in hot spots and areas of concern.
>
> By 2025, to ensure that point sources and air emissions from industrial sector would be in conformity with the provisions of the LBS Protocol, and other agreed international and national provisions.

The national BB of releases of targeted substances for the reference baseline period of 2002-2003, should serve as a reference level with respect to which, progress in the desired reduction of releases could be assessed.

By definition the national BB for a particular pollutant, is the sum total of the releases of that pollutant from a particular administrative region (in the case of Malta and Gozo, a single administrative region comprising all the national land territories, is being considered) within the area of jurisdiction.

The national BB as is being presented in the present document has been compiled by the present author as national expert commissioned by the Coordinating Unit for the Mediterranean Action Plan (UNEP), with the assistance of the Environment Protection Directorate.

Both the present national BB report and the NDA report are being submitted simultaneously to UNEP/MAP, and as such should be read concurrently, since they are meant to compliment each other.

1.2 Data Availability

Both reports are based on archived data and no new data have been generated for the purpose of the compilation of such reports. This is because of the limited resources available for such an initiative as well as the tight schedule and deadlines within which we had to complete the reports.

The archived data which is currently available is very limited and incomplete. It includes:

a) The identification of all major point discharges into the marine environment;
b) Estimated flow rates and volumes of discharged wastewaters from such point discharges;
c) Preliminary chemical profiles of the more relevant wastewaters being discharged.

While the scientific reliability of this data is quite satisfactory, we feel that it is insufficient (both in respect of parameters measured, as well as in its temporal scale) to enable us to produce an **accurate** estimate of the annual baseline budget of releases of the SAP-targeted and locally relevant marine pollutants. Nonetheless, we will have to base most of our BB on such data, taking into full consideration such limitations.

In the meantime, we feel that the data availability required to establish current status and trends is sufficient to enable us to compile a NDA report as required.

1.3 Different Compilation Methodologies for the National BB

The national BB for each specific pollutant or class of pollutants was originally to be computed according to guidelines as prepared by UNEP/MAP (2002). Such guidelines stipulated the following steps:

a) Preparation of an inventory of industry;
b) Classification of such industry and industrial activities in sectors according to the LBS Protocol;
c) Identification of the potential industrial sources of each targeted pollutant;
d) Estimation of the annual release of each pollutant from each industrial source on the basis of level of industrial output, manner of operation and the application of emission factors (EF);
e) Computation of total national BB for the respective pollutant for all industrial sources on an annual basis.

This methodological approach is quite logical and in the absence of actual monitoring data on the levels of pollutants in point (or diffuse) sources of discharges, it would be expected to produce a reasonable picture of the level of releases of the various pollutants in the environment as resulting from specific industrial operations. However the reliability of such an approach is totally dependent on:

- Reliable and updated information on the individual industrial operators as well as on their manner of production;

- Availability of EFs for each type of industrial operation which is relevant to a particular region and to the particular mode of production;

- Validation of such EFs for their eventual application to a particular region.

Very early on during the preparation and compilation of the present national BB, it was made clear to the MAP Unit in Athens, that the above conditions which would render the "emission factor" approach valid and reliable for the case of Malta, could not be met. Data availability and accessibility on types and levels of operations of targeted industrial sectors as well of importation and level of use of relevant chemicals are quite limited. There are also no national EFs. Furthermore, most of the 'default' EFs being adopted by MAP for the purpose of the present exercise (as indicated in UNEP/MAP 2002, and in subsequent documents and software developed for this purpose) are available for industrial sectors and operations which are locally either non-existent or irrelevant. On the other hand, no EFs have been identified or are available for a number of industrial operations that are extremely relevant to Malta. In the meantime, MAP was unable to provide us with the national EFs which may have been adopted by other Contracting Parties for the purpose of this exercise. This could have assisted us to decide whether we may at least partially apply such EFs to the local context.

In the opinion of the present author, the application of EFs which are themselves reliable only in very limited circumstances (as generally indicated by the authors who originally proposed them) may produce an 'over-estimated' BB of releases for SAP-targeted chemicals, giving a grossly unreliable index of progress towards achieving the 30-50% reductions in such releases as stipulated by SAP by 2010.

Under these circumstances, it was felt that it would be much wiser to adopt an 'end of pipe' and 'source oriented' strategy for the compilation of the BB rather than 'load oriented' approach, through the application of EFs. This means that in most cases, the BB for a particular pollutant will be computed on the basis of data on concentrations of such pollutant in the various wastewaters released from identified point sources of discharges, as well as on the annual flow rates of such discharges. This strategy was approved by UNEP/MAP (Mr. Fouad Abousamra, personal communication, 19 November 2003).

1.4 Limitations

A number of limitations and constraints which were encountered during the compilation of these reports have already been identified in the previous sections. These include:

- Incomplete information and data;

- Lack of national emission values;
- Unavailability of information on EFs being adopted by other countries in the compilation of their own national BB.

In addition, the following limitations and constraints have to be highlighted:

Though constant contact was maintained with the MAP Unit Athens during the compilation of the present reports (through submission of progress reports and exchange of correspondence), the author did not have the opportunity to attend any expert meetings organized by the MAP Unit. In fact, one such meeting was held in December 2002, a few weeks before the present author was appointed as an expert for these initiatives. As such, the present author did not have the opportunity to share information and exchange views and opinions with experts from other Contracting Parties.

The level of collaboration with other national entities in the compilation of the present reports was well below that desired and originally hoped for. In fact, key information and data that were requested from various industrial sectors on the quality and quantity of their direct marine discharges were never made available, or not adequately updated for the purpose of this national BB. Vital information, such as on actual flow rates of wastewater discharges from public sewers, was not made available by the Drainage Department.

The above limitations have to be successfully addressed in the next phase of formulation and implementation of the NAP, if its aims and stated objectives are to be attained.

2. Archived Data as the Basis of the Present BB

The present Baseline Budget is based on the following archived data that was available by the time of writing:

An inventory of point sources of marine discharges, together with estimated flows;

Preliminary chemical profiles of the more relevant wastewaters being discharged.

The inventory of marine discharges has been first compiled by the present author on commission by the Environment Protection Directorate within the framework of an assessment of cost of compliance with EU relevant EU Directives, and in particular with Council Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (OJ 1976, L 129/23).

Preliminary chemical profiles for a number of the more relevant point sources of marine discharges are also available as a direct result of monitoring programmes undertaken with the same framework of assessment of degree of compliance with EU Directives.

In the following section, the features of such archived data, and in particular, their limitations, as well as the manner in which such data has been utilized for BB compilation, will be reviewed.

2.1 Inventory of Direct Marine Discharges into the Marine Environment

Council Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community is currently main directive on measures to protect the aquatic environment from pollution by substances listed in the annex to the Directive. This annex contains List I substances that are particularly dangerous because of their toxicity, persistence and bio-accumulation and which are in most cases the same as the SAP-targeted substances, and List II substances, which are less dangerous but which have a deleterious effect on the aquatic environment. The ultimate aim is to eliminate the discharges of List I substances and to reduce those from List II.

List I

- Organohalogen compounds
- Organophosphorus compounds
- Organotin compounds
- Carcinogenic teragenic and mutagenic substances
- Mercury and its compounds
- Cadmium and its compounds.

- Persistent mineral oils and hydrocarbons
- Persistent synthetic substances which interfere with water use

List II

- List I substances not regulated
- Other metals and metalloids
- Other Biocides
- Substances which affect taste/smell
- Toxic organic Silicon compounds
- Inorganic phosphorus compounds
- Non-persistent mineral oils
- Fluorides and cyanides
- Substances which affect the oxygen balance (ammonia, nitrites)

The Directive provides for the setting up an authorization system, as well as for the drawing up of an inventory of discharges into the waters covered by the directive. This inventory should include discharge sources which may contain substances within List 1 to which emission standards are applicable.

Such an inventory was first set up in 2000 for the Ministry for the Environment (Axiak and Delia, 2000). It was subsequently updated in December 2001 and more recently in March 2003 (Axiak, 2003).

Details of this inventory, with selected information on each identified land-based point source of discharge has been presented in the NDA report.

The inventory is to be considered as a draft and preliminary. This is because it is based on an incomplete dataset of information.

The discharge points which it includes are those significant land-based point sources which may be identifiable at this stage. Furthermore, point sources are defined as those points of discharges of waste water which may collect effluents from one or more inland or sea-based activities and which discharge directly on the shoreline or at some distance out into the sea. This means that point sources of discharges of industrial effluents into the public sewers will not be taken into consideration. These will be covered indirectly by inclusion of the marine discharge points of the public sewers themselves (e.g. sewage outfalls).

Council Directive 76/464/EEC applies to inland surface waters, territorial waters, internal coastal waters and ground water (Article 1). This inventory covers land-based point discharges into the marine environment (territorial and coastal marine waters). No significant permanent inland surface waters exist in Malta.

2.1.1 Methodology of Inventory Compilation

The inventory is based on: a review of very limited archived data, interviews with industries and field monitoring.

Repeated attempts to identify any archived data on industries having direct marine discharges proved to be unsuccessful. Neither the Malta Environment and Planning Authority, nor the Malta Resources Authority, or any governmental departments have any reliable data that could be used as a basis to comply a detailed inventory of direct marine discharges of wastewater effluents.

The methodology which was eventually adopted initially involved the mailing of letters of inquires to a large number of industries, followed by the holding of interviews with those industries which could potentially have such marine discharges. In each case, information on the quantity and quality of discharged effluents was collated and wherever possible verified. For this purpose a questionnaire was designed and used during these interviews.

Interviews were conducted during the period July-September 2000. In many cases, the interviews were conducted with the full cooperation and assistance of the industries involved. Nonetheless a number of problems have been encountered during this exercise, some of which will be outlined below.

In very few cases, the company initially reported that it does not discharge any wastewaters into the sea. Subsequently on further investigations, such marine discharges were confirmed.

In other cases, the claim made by some companies that they were not discharging wastewaters into the sea, was confirmed.

In one particular case, the company stated that it does not have direct marine discharges. However repeated investigations indicated that such discharges did occur but on an irregular basis, possibly due to some malfunction of the plant.

In some cases, multiple interviews had to be held with a specific industrial concern, due to the degree of complexity involved. For example, over 15 different interviews were held with various sectors and divisions of the Malta Drydocks (now Malta Shipyards Ltd.,) resulting in a massive body of information regarding the nature of marine discharges from this major industrial complex.

Very often, a particular industrial concern would be unable to provide the necessary quantitative data during or immediately after the interview. This was the main reason why the completion of the report had to be delayed. Furthermore there were cases, where data that was promised to us never reached us.

Furthermore, many industries were unaware of their potential obligations for the treatment of their own liquid wastes prior to their discharge into the marine environment. In many cases, the work team itself had to identify potential treatment options and the associated technical details, before it could arrive at a reasonable assessment of the compliance cost involved.

In an effort to update this inventory, all operators which were included in the first compiled inventory (Axiak 2001), were requested in December 2002, to confirm and if necessary update the relevant information available till then. Unfortunately, only 35% complied with our request. Furthermore, 28 other potential operators that could have some direct marine discharges were contacted. However none of these operators confirmed any new direct marine discharges.

2.2 Chemical Profiles of Discharges

The studies undertaken in 2000 and 2002 generated a significant amount of original quantitative data on the quality of effluents discharged into the marine environment, through field monitoring programmes involving the sampling and analysis of both undiluted wastewaters from land-based point sources of discharges, as well as water samples from inshore areas. Results are presented in Axiak and Delia (2000) and Axiak (2003b).

Furthermore, in January 2003, a monitoring programme was carried out by EPD, whereby a number of marine discharge points (including sewage wastewaters, dock waters from ship yards, and wastewaters from Marsa and Delimara power stations) were analysed. The number of samples involved ranged from 2 to 15.

The data collected from these monitoring programmes were made use of in the updating of this inventory and eventually in the computation of the national BB. The main problem in pooling of such data is that in some cases, different analytical methodologies with different lower detection limits may be used. This was particularly the case for the analysis of oil and their products. In some cases, total oil content was measured by solvent extraction followed by gravimetric analysis. In other cases, the petroleum hydrocarbons were measured using gas chromatography.

In various cases, while the value of BOD5 was available for a particular sample, the value of COD5 had to be estimated.

2.3 Quality of Data

The reliability of our assessment of direct marine discharge points will evidently depend very much on the accuracy of the information supplied to the present consultant. In this respect, it is worth to make the following observations:

In our estimation of volumes and rates of discharges if wastewaters, we had to depend on the semi-quantitative data as supplied by the industrial complex being investigated. In most cases, it was evident that such data was quite an approximation. In fact almost none of the discharge points were equipped with flow meters. Furthermore, most of the data on flow rates were initially made available in terms of m^3 per minute or per week. Subsequently, the estimation of annual volumes of wastewaters discharged had to take in consideration fluctuations in operations on a daily basis, as well as on a monthly or seasonal basis. In most cases, the frequency of discharge for a particular point source was not known and had to be estimated on the basis of experience and common sense.

In computing the baseline budget for a particular pollutant as released from a specific point source of discharge, whenever possible, our computation was based on actual data on levels or concentrations of that pollutant in the respective wastewaters being released. In most cases, measured data on actual levels were very limited in terms of replicates and this has to be taken into account in the final assessment.

Whenever no such data was available, and in those cases where a particular pollutant was evidently present in the wastewaters being assessed, as ascertained by the operator himself or as indicated by the type of industrial operation involved, then a baseline budget was computed on assumed levels of the pollutant. Such assumptions were based on consideration of the type of industrial activities and operations, which gave rise to the wastewaters, as well as the type and quantities of chemicals used for such operations. In many cases, the company was able to provide us with official Material Safety Data sheets for all such chemicals. Furthermore, we made use of any available archived data on the quality of waters in the vicinity of the given discharge. Only in very few cases, did the company in question carry out any chemical monitoring of constituents in its discharged wastewaters.

3. Baseline Budget Computation

3.1 Sectors Considered

The inventory of direct marine discharges, on the basis of which the national BB was computed, classifies such discharges in eight major categories as follows:

- Fish Farming (FF)
- Freshwater Production (RO)
- Electricity Generation (PS)
- Oil and Fuel Terminals (OT)
- Shipyards (SY)
- Other Industry (IN)
- Hotels and Recreation (HR)
- Wastewater Discharges through public sewer outfalls (SG)

Subsequently, the BB for the respective pollutants or classes of pollutants, is being computed separately for each sector as identified above. However, as pointed out in the NDA report, the national sewer systems collect both domestic and industrial wastewaters, and therefore we are not able to distinguish between the two when computing BB based on releases from sewers. Nonetheless, it is pertinent to point out that most local industries discharge their wastewaters into the public sewers. Such discharges are controlled by Legal Notice 139 of 2002 (Sewer Discharge Control Regulations, 2002) in order to reduce the levels of biodegradable organic matter, nutrients as well as suspended solids in addition to other chemicals that may damage sewers as well as the receiving treatment plant or the marine environment, after being discharged through sewage outfalls. Unfortunately, as yet, the level of compliance of local industry with such official controls, is low. Therefore it may be assumed that a significant proportion of the loads of relevant pollutants such as heavy metals and POPs being currently released into the marine environment from sewage outfalls, are in fact originating from local industrial sectors.

3.2 Two-Case Scenarios

Due to the level of uncertainty attached to the quality of data as has been identified in Section 2.3, it was deemed opportune to adopt a best-case and a worst-case scenario in the estimation of the BB for each individual point source of discharge. This was possible since:

- The BB was computed by multiplying the known or assumed concentration of a particular pollutant in the respective discharge, by the estimated annual volume of discharge;
- In the estimation of the annual volume of discharge, it was possible to make a conservative estimation based on the more probable lower volume, as well as

upper worst-case estimate assuming a higher degree of operation. In most cases, the operators themselves provided an upper and a lower level of estimated rates of discharge.

- Whenever enough replicates where available for measured concentrations of a particular pollutant, it was possible to compute 95% confidence limits for the mean concentration. In such cases, the best-case scenario concentration was estimated using the computed mean level, while the worst-case scenario concentration was computed using the higher 95% confidence limit.

Therefore, in estimating both the best-case scenario (lower level), and worst-case scenario (upper level) BB for a particular pollutant, it was possible to give an indication of the level of uncertainty for the quoted BB.

The resultant BB per sector for the various relevant pollutants or classes of pollutants as computed for the present study is presented in **Table 1**. The chemicals covered include those which are SAP-targeted (wherever data on the respective chemical(s) were available) as well as others which are relevant to the local context.

When the BB for a particular pollutant or class of pollutants is indicated as zero, it means that all reported levels or concentrations for the respective pollutant in the samples analysed were below detection limits. Such detection limits varied between different monitoring programmes.

Before proceeding with a review of the main results, it would be opportune to make a number of observations regarding certain classes of pollutants as being presented in Table 1.

The BB for total Nitrogen includes all measured Nitrogen forms such as ammonia, nitrites, and nitrates. The BB for total Phosphorus includes that of phosphates.

Except for butyltins, no data on organometallic species were available. Therefore, the BB for heavy metals generally includes all forms of the respective metal.

In the case of hydrocarbons, a distinction is being made between petroleum hydrocarbons and total oil content. In the former case, the BB includes mostly the non-persistent as well as persistent petroleum fractions as measured using gas chromatography. Total oil content includes all forms of oil and hydrocarbons including grease and biogenic oils.

In the case of butyltins, the BB being presented includes that for tributyltin (TBT, which is the main active antifouling agent) as well as that for its metabolites or degradation products, i.e., dibutyltin (DBT) and monobutyltin (MBT). TBT is known to be relatively non-persistent in waters and rapidly breaks down into DBT and MBT. Therefore a measure of all butyltins will give a better indication of both recent and less recent pollution by this pollutant.

Table 1: Baseline Budget of Releases of Pollutants into the Marine Environment of the Maltese Islands (in kg per year) for different sectors.

	BEST CASE SCENARIO *(for details see text)*							
Sector	Fish-Farming	Potable Water Production	Energy Generation	Oil and Fuel Terminals	Shipyards	Other Industry	Public Sewers	Total National Baseline Budget
COD5	4,798.2		19,429.7	4,800.0	720.3	133,870.0	3,641,033.8	3,804,652.00
BOD5	3,198.8		12,953.2	3,200.0	480.2	102,580.0	3,020,537.5	3,142,949.68
Total Nitrogen (inc nitrites, nitrates, ammonia)	366.5	6,304.1	30.9	25.5	13.0	20,370.0	485,562.0	512,671.99
Total Phosphorus	11,644.7	13,789.4	643.5	335.0	17.1	9,573.9	241,123.8	277,127.39
Total suspended solids	6,072.1		9,343.4	1,050.0	891.1	122,220.0	2,949,652.2	3,089,228.69
Mercury (and organomercuric)	0.0	0.0	0.0	0.0	0.0	0.0	44.4	44.41
Cadmium	0.0	0.0	75.0	0.0	1.5	0.8	13.2	90.49
Lead (and organolead)	0.5	3.2	34.0	4.0	0.4	8.0	85.0	135.15
Nickel	69.1	325.1	61.2	12.8	1.2	0.0	78.2	547.68
Arsenic	0.3	53.2	0.2	0.0	0.0	8.0	48.0	109.84
Chromium	0.1	6.9	0.3	0.0	0.0	2.9	27.0	37.23
Copper	0.8	23.7	1.4	3.4	1.0	1.0	101.9	133.37
Manganese			0.0	0.0	0.0	0.0	0.0	0.00
Selenium	0.0	73.5	0.0	0.0	0.0	0.0	0.1	73.58
Zinc	7.2	1,205.6	15.1	0.6	1.1	29.8	1,009.9	2,269.40
Antimony			0.0				0.0	0.00
Barium			0.0				0.0	0.00
Beryllium			0.0				0.0	0.00
Boron	2,046.0	15,361.9	25.0	20.0		93.6	1,183.4	18,729.83
Tin						24.8	317.4	342.16
Parathion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Malathion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Cypermethrine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Dichlorvos	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Aldrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Dieldrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Endrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Isodrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hexachlorocyclohexane (Lindane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
DDT(Dichlorodiphenyl trichloroethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
PCB			0.0	0.0	0.0	0.0	0.2	0.20
1,2 Dichloroethane	0.0		0.0	0.0	0.0	0.0	0.0	0.00
Trichloroethylene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05
Carbon Tetrachloride		0.0	0.0	0.0	0.0	0.0	0.0	0.00
Pentachlorophenol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hexachlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hexachlorobutadiene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Trichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Chloroform	0.3	15.2	0.2	0.0	0.0	0.1	0.7	16.38
Perchloroethylene	0.1	4.3	0.0	0.0	0.0	6.9	101.4	112.69
Petroleum Hydrocarbons (especially the more volatiles fractions)	221.2		1,792.9	150.0	8.2	120.0	8,260.4	10,552.66
Total Oil (including grease, persistent PHC and biogenics)	0.0	0.0	2,133.9	190.0	61.3	11,000.0	147,162.3	160,547.50
Total Butyltin compounds	0.3		0.2	0.0	0.0	0.0	0.4	0.90
Cyanides	0.0		0.0	0.0	0.0	1.0	63.1	64.07
Fluorides	486.6		291.9	42.0	7.0	65.0	2,303.5	3,195.95

Note: 0 = Levels below detection limits / No figure indicates that no data is available.

Table 1: **(Continued) Baseline Budget of Releases of Pollutants into the Marine Environment of the Maltese Islands (in kg per year) for different sectors.**

	WORST-CASE SCENARIO *(for details, see text)*							
Sector	Fish-Farming	Potable Water Production (Desalination)	Energy Generation	Oil and Fuel Terminals	Shipyards	Other Industry	Public Sewers	Total National Baseline Budget
COD5	13,934.4		24,800.0	10,022.4	1,007.4	334,750.0	6,642,781.6	7,027,295.79
BOD5	9,289.6		16,533.3	6,681.6	671.6	256,500.0	5,645,203.2	5,934,879.33
Total Nitrogen (inc nitrites, nitrates, ammonia)	1,143.5	14,457.6	220.6	53.2	37.9	50,800.0	944,993.1	1,011,705.94
Phosphates	34.5	221.9	30.3	9.4		5,588.0	107,851.4	113,735.41
Total suspended solids	18,092.0		10,810.2	2,192.4	3,197.8	304,800.0	6,695,434.2	7,034,526.54
Mercury (and organo mercuric)	0.0	0.0	0.0	0.0	0.0	0.0	199.8	199.84
Cadmium	0.0	0.0	175.0	0.0	4.0	2.0	97.1	278.14
Lead (and organolead)	1.6	4.8	203.9	8.4	1.7	20.0	1,696.3	1,936.58
Nickel	216.0	760.8	243.1	26.7	7.9	0.0	1,418.6	2,673.20
Arsenic	1.0	110.3	0.5	0.0	0.0	20.0	415.1	547.02
Chromium	0.2	10.9	2.4	0.0	0.0	7.3	142.0	162.78
Copper	2.6	45.7	5.6	7.0	7.6	2.6	1,497.9	1,568.96
Manganese			0.0	0.0	0.0	0.0	0.0	0.00
Selenium	0.0	185.8	0.0	0.0	0.0	0.0	1.7	187.45
Zinc	22.5	2,059.6	61.8	1.3	6.3	74.5	11,185.7	13,411.77
Antimony			0.0			0.0	0.0	0.00
Barium			0.0			0.0	0.0	0.00
Beryllium			0.0			0.0	0.0	0.00
Boron	6,393.6	43,858.1	125.0	41.8		234.0	8,011.2	58,663.66
Tin			0.0			62.0	1,153.1	1,215.06
Parathion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Malathion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Cypermethrine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Dichlorvos	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Aldrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Dieldrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Endrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Isodrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hexachlorocyclohexane (Lindane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
DDT(Dichlorodiphenyl trichloroethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
PCB			0.0	0.0	0.0	0.0	5.2	5.18
1,2 Dichloroethane	0.0		0.0	0.0	0.0	0.0	0.0	0.00
Trichloroethylene	0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.11
Carbon Tetrachloride		0.0	0.0	0.0	0.0	0.0	0.0	0.00
Pentachlorophenol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hexachlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hexachlorobutadiene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Trichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Chloroform	1.0	23.7	0.3	0.0	0.0	0.1	10.5	35.64
Perchloroethylene	0.2	8.3	0.1	0.0	0.0	17.3	2,071.2	2,096.97
Petroleum Hydrocarbons (especially the more volatiles)	691.2	0.0	6,599.1	3,132.0	11.5	300.0	43,765.9	54,499.77
Total Oil (including grease and persistent PHC)	0.0	0.0	8,054.6	396.7	225.4	27,500.0	557,784.5	593,961.15
Butyltin compounds (and other organotin compounds)	0.8		0.7	0.0	0.1	0.1	8.0	9.67
Cyanides	0.0		0.0	0.0	0.0	2.5	628.2	630.71
Fluorides	1,520.6		300.6	87.7	8.6	162.5	6,086.3	8,166.37

Note: 0 = Levels below detection limits / No figure indicates that no data is available.

3.3. Fish Farming Sector

A total of 250,000 m^3 of wastewaters or production waters had originally been estimated to be discharged directly into the marine environment as a result of fish farming operations (see NDA report). For the purpose of the national BB this figure is being updated to 0.6 (best case scenario) or 1.7 million (worst case scenario) m^3 per year. These wastewaters arise from at least 4 land-based plants, while other point sources of discharges arise from service ships (in connection with tuna penning). Nonetheless, more than 95% of this volume was being discharged by a single source, namely: the San Lucian Aquaculture Centre in Marsaxlokk. Wastewaters are generated mainly from holding fish tanks.

Unfortunately, extremely limited data on the chemical profiles of such discharges is currently available. In fact, only a single sample of wastewaters discharged from the San Lucian Aquaculture Centre had been analysed chemically and results have been quoted by Axiak and Delia (2000). Requests for further information have been ignored. Furthermore, three other fish farm operators which have land-based sites discharging wastewaters into the sea (arising from net washing and packing plants), do not carry out as yet, any chemical monitoring of such wastewaters. These wastewaters may be expected to carry significant amounts of suspended solids as well as organic matter, and it was possible to make reasonable assumptions for COD, BOD and levels of suspended solids, as well as nutrient levels, for the purpose of computing the BB for this sector.

The resultant BB for releases from this sector indicates that as expected the most important pollutants include nutrients, suspended solids and biodegradable organic material (BOD5 and COD5). Boron and nickel also feature quite prominently, though it is quite likely that these are not completely arising as a result of the land-based operations but may be found also in the feed water. Lower levels of oils and of fluorides are also evident.

3.4 Potable Water Production Sector

There are currently three reverse osmosis plants operated by Malta Desalination Services Ltd. which supplies about 50% of Malta's drinking water supply. These are located at Lapsi, Cirkewwa and Pemboke. The RO plant at Pembroke produces the largest amount of water (as much as 54% of the total volume in 1996-1997).

The existing RO plants make use of Du Pont Permasep B-10 permeators membranes. Several chemicals are used for their cleansing and further treatment. Brine wastewaters as well as membrane wash waters produced during back-flushing of the membranes, are discharged directly into the sea. Brine waters are discharged at approximately 1^o C above ambient temperature. Their pH is in the range of 6.2 to 6.8.

Only flow rates are monitored for the discharged wastewaters and no chemical monitoring of such production waters is carried out. The total estimated volumes discharged by this sector amounts to 24 to 46 million m^3 per year.

In 2000, (Axiak and Delia, 2000), one sample of discharged waste waters was collected and analysed for the relevant chemicals, from each of the three RO plants. For this sector, the BB for heavy metals arising from the release of such brine waters was computed using the concentration levels of the respective metal as found in the outlet, minus that as found (or as assumed) at the surface of inshore waters in the vicinity of RO plant at Ghar Lapsi (data obtained from Peplow, 1986).

Evidently, the amount of quantitative data available is insufficient to be able to make a thorough assessment and the resultant computed BB needs further verification in the second stage of the NAP.

Nonetheless, a number of indicative observations may be made at this stage. The main chemicals of concern which were detected in these discharged wastewaters are: boron, and to a lesser extent, zinc and nickel. While it is more likely that such heavy metals are originally found in the feed waters and are being concentrated in the discharged brine stream (e.g. boron background levels in the seawater may already be high) it is to be noted that the present BBs for heavy metals (and other pollutants) arising from this sector were computed on the basis of concentrations in discharged wastewaters as corrected for levels in the feed waters or at the inlet (as estimated from literature, and as indicated above). Evidently there is a need for a more thorough study of this issue.

3.5 Energy Generation

Malta has two power stations at Marsa and at Delimara with both stations working together in a network. The Delimara Power Station (DPS) has a production capacity of 305 MW, of which 75 MW are only produced when the country is in a state of emergency (Enemalta Chairman as reported in Malta Independent on Sunday, 19 Nov. 2000). The Marsa Power Station (MPS) has a capacity of 270 MW. It includes 8 steam turbines (commissioning dates: 1966 to 1987) and 1 gas turbine which was commissioned in 1990. All fuel is currently heavy and/or light fuel oil. For 1999, the rate of consumption of fuel oils per year were 350,000m^3 heavy fuel oil and 2800 m^3 light Fuel Oil. The MPS complex includes a fuel oil storage capacity of 35,000 m^3 of heavy fuel oil and 1400 m^3 of light fuel oil. All fuel oil tanks are bunded.

The DPS includes 2 steam turbines (commissioning dates: 1991-92); 2 gas turbines (1995) and one combined cycle turbine. All fuel is currently heavy and/or light fuel oil. For 1999, the rate of consumption of fuel oils per year was 186 000 tons/year. The DPS complex includes a fuel oil storage capacity of 50 000 m^3 of fuel oil. All fuel oil tanks are bunded.

3.5.1 Waste Waters/Production Waters Generation

Figure 3.1 shows the various operations within the two power stations which generate various wastewater streams. All streams are discharged directly on the shoreline at inner Marsa (along Church Wharf) for MPS, and at Hofra z-Zghira for DPS.

In the case of the MPS, the dewatering of fuel oil (**Discharge 1**) during storage produces approximately 800 m^3 of wastewater per year. This is led to settling tanks (as does all rain water runoff) and then to an oil interceptor. Boiler Washings produce an annual volume of discharge of approximately 760 m^3. The rate of this discharge is not regular but is usually at 0.1m^3/min. These effluents (**Discharge 2**) would carry high levels of suspended solids. Other chemical additives may be expected in these effluents. Boiler blow-down waters also generate another waste-water stream (**Discharge 3**) with a number of likely contaminants including: suspended solids, copper, iron, silica and other additives (such as trisodium phosphate, sodium hydroxide and synazine. Currently these waters are not led to a settling tank to reduce suspended and settable solids. There is also no pH control.

By far, the most significant wastewater stream generated in a power station is that of cooling waters (**Discharge 4**). For Marsa Power Station, the annual volume of such cooling waters which are discharged into the Grand Harbour (inner Marsa) may amount to 250 million m^3. The rate of discharge is usually at 500 m^3/minute. Enemalta officials claim that these effluents are discharged at approximately 4^o to 8^o C above ambient. These effluents also contain antifouling agents: chlorine at 1-2 mg/L (for 3 hours every 24 hours) and Clam- trol at 18 mg/L (for 24 hours every 1.5 months).

At the Demineralisation Plant (which produces water of the correct quality for the boilers, waste waters (**Discharge 5**) are produced during regeneration of ion resins. The estimated annual volume for this stream amounts to 150 m^3. The likely contaminants are suspended solids, and chemical additives. Finally, brine water from the evaporators (**Discharge 6**) are produced an annual estimated volume of 641,000m^3 and at a discharge rate of 1.25 m^3/min. The likely contaminants in this discharge stream include suspended solids and other chemical additives such as Belgard as antiscale and Belite as antifoam.

In the case of DPS, the dewatering of fuel oil (**Discharge 1**) during storage produces approximately 100 000 m^3 of waste water per year. This is led to settling tanks (as does all rain water runoff) and then to an oil interceptor. There is evidence to suggest that such oil interceptor is in fact not presently in use. Boiler Washings produce an annual volume of discharge of approximately 400 m^3. These effluents (**Discharge 2**) are discharged at sea after settling and pH neutralization. No detailed information regarding their chemical composition is available. Suspended solids in such a stream may contain sulphur, nickel, vanadium and iron compounds.

Boiler blow-down waters also generate another wastewater stream (**Discharge 3**) at a discharge rate of 0.7 m^3/hour. These waters are led to a settling tank and a neutralization pit to reduce suspended and settable solids as well as control pH.

Discharge 4 is that of cooling waters and as for Delimara Power Station, the annual volume of such cooling waters which are discharged into Hofra iz-Zghira may amount to 250 million m^3. The rate of discharge is usually at 500 m^3/minute. Enemalta officials claim that these effluents are discharged at approximately 4^o C above ambient. These effluents also contain antifouling agent: chlorine at 1-2 mg/L (for 3 hours every 24 hours).

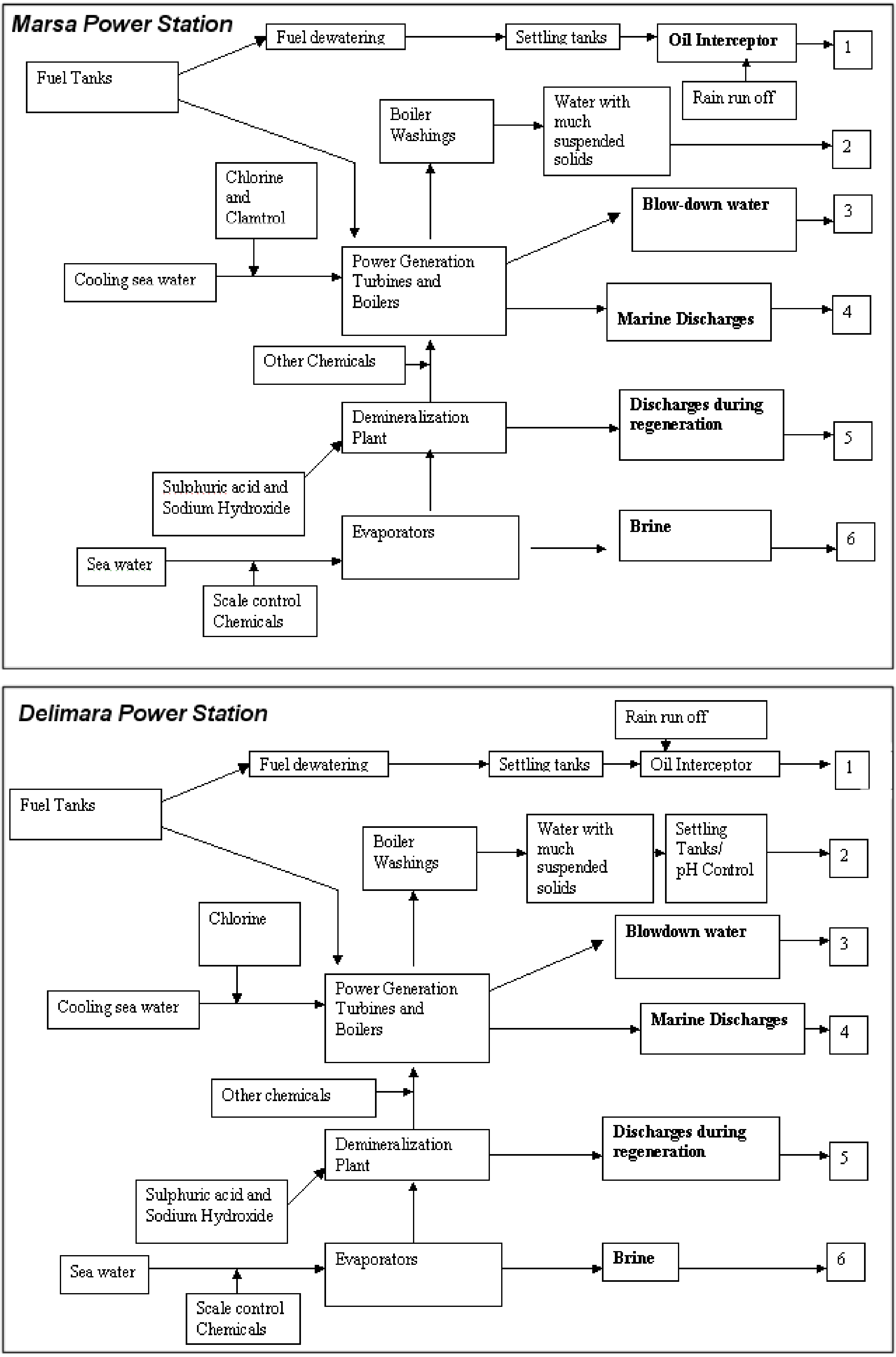

Figure 3.1 Layouts of the more relevant operations of the Marsa and Delimara Power stations showing the generation of the different wastewater streams

At the Demineralisation Plant (which produces water of the correct quality for the boilers, waste waters (**Discharge 5**) are produced during regeneration of ion resins. The estimated annual volume for this stream amounts to 155 m^3 at a discharge rate of approximately $3m^3$ per week. The likely contaminants are suspended solids, and chemical additives. Discharges containing residual sulphuric acid and caustic soda are neutralized before discharge in the sea.

Finally, brine water from the evaporators (**Discharge 6**) are produced an annual estimated volume of 570 000 m^3 and at a discharge rate of 1.1 m^3/min. The likely contaminants in this discharge stream include suspended solids and other chemical additives such as Belgard as antiscale (annual consumption: 8 tons per year).

3.5.2 Chemical Profiles of Marine Discharges

Axiak and Delia (2000), and Axiak (2003) have reported on the chemical profiles of some of these discharge streams as arising from the MPS and the DPS and as monitored during two relatively short periods in 1999 (2-3 samples) and 2002 (6 samples). More recently the Environment Protection Directorate had monitored some of thee discharge streams in January 2003 (6 – 11 samples). All these results were made use of for the computation of the present BB arising from these two power stations.

One major problem encountered in the BB computation for this sector, was the relatively huge volumes of discharge of cooling waters involved. This means that even if the level of a particular pollutant is exceedingly low, the resultant estimated BB would be significantly high. Any slight modification in the level of pollutant used for computing the respective BB, would result in a substantially different BB value. To complicate matters, most of these discharged waters are being retrieved from the environment which, especially in the case of Marsa, is already polluted. Therefore, we may not assume that the entire pollutant load that is being released from the outlet is originating from the plant itself. Subsequently, for computing the BB for this sector, different streams were considered separately (whenever possible), and in the case of cooling waters, the BB was computed using the concentration levels of the respective pollutant as found in the outlet, minus that as found (or as assumed) at the inlet.

3.5.3 Resultant BB from the Energy Generation Sector

While annual BB for the respective pollutants is available for each power station, Table 1 shows the combined BB for both MPS and DPS.

The present data indicate that this sector may be contributing a significant proportion of biodegradable organic loads which are currently being released from land-based sources. This was particularly evident for the DPS. Total suspended solids are also relatively high (though they still represent less than 1% of the total national BB for suspended solids).

Cadmium releases from this sector, though extremely low in absolute terms (75 to 175 kg per year), are the highest in terms of percentage contribution to the national BB for cadmium for all sectors. Furthermore, appreciable cadmium releases were noted for both power stations. In view of the high toxicity of this metal, the second phase of the NAP will need to investigate this issue further. This sector's BBs for Nickel and Chromium are also appreciable.

The BB for petroleum hydrocarbons for this sector was also relatively high (amount to 12% to almost 17% of the total PHC releases from all sectors).

This sector also makes relatively high contributions to the release in the marine environment of lead, butyltins and nickel, as well as fluorides.

3.6 Oil and Fuel Terminals

The industrial sector dealing with fossil fuels is an important factor determining the national economy. Malta imports all its fossil fuel requirements, which may amount to a global volume in excess of 1,000,000 metric tones per year. In 1999, Enemalta's Petroleum Division imported 900,000 metric tones of petroleum products, 55% of which were fuel oil.

Seven separate marine discharge points arising from 5 oil and fuel terminal installations are included in the inventory. Wastewaters from these sites are mainly generated from dewatering of fuels during storage, or from oil-water separation of ballast waters, or from rainwater runoff.

The estimated total volume of such wastewaters was originally estimated to be approximately 242,100 m^3 per year in 2000 (Axiak and Delia, 2000). This figure has to be significantly updated for the purpose of the present report as based on more recently available data as provided by some of the operators themselves. It may now be roughly estimated that the total annual volume of wastewaters as discharged by this sector may amount to 50,000 to 100,000 m^3. The high degree of uncertainty about this figure mainly arises from the fact that no actual measurements of such flow rates are undertaken by most of the operators involved. Furthermore, the figures do not include a substantial amount of rainwater which is collected annually over the operational area including bunded spaces) and which is discharged into the sea. Such runoff water is known to carry varying traces of oil.

75% to 90% of this estimated total volume of annual marine discharges arising from this sector originates from a single terminal (Malta Shipyard's Rinella Tanker Cleaning Facility).

Again, only limited data are available on the chemical characteristics of such wastewaters, which might be expected to be sources specific. Most of these samples were obtained from the Rinella Tanker Cleaning Facility. As expected, the most significant contaminant in these wastewaters was determined to be petroleum hydrocarbons, with several heavy metals such as nickel, boron, lead, copper and zinc, featuring as well. The BOD loadings of some samples was also found to be relatively high.

For the computation of the worst-case BB scenario, the concentration of petroleum hydrocarbons was assumed to be 15 mg/L, which is normally the upper permissible level of these contaminants from land-based sources.

The resultant BB for the various pollutants released by this sector shows that while in absolute terms, petroleum hydrocarbons feature quite prominently (as expected), in the worst-case scenario this sector will contribute only 6% of the total BB for PHC for all sectors. Releases of lead, copper and other heavy metals as well as of biodegradable organic matter from this sector are also not insignificant.

3.7 Shipyards

This sector is one major component of the local industrial context, both in terms of employment, as well as in terms of reserves of foreign currencies and the multiplying effects it exerts on other industrial sectors.

Due to the nature of their operations, these ship repairing/building yards, complete with fixed or floating docks, are expected to give rise to point sources as well as diffuse sources of marine discharges. Five companies have been included in the inventory which are: Malta Shipyards (MS) (Cottonera), MS Yacht Repair Yard (Manoel Island) Cassar Ship Repair, Bezzina Shipyard and Marsa Ship Building. Most of the data on the chemical constituents in the marine discharges come from the Malta Shipyards.

Axiak and Delia (2000) had identified and reviewed the significance of a number of different wastewater streams being discharged into the marine environment, as arising from this sector, and in particular, as arising from the MS. In the latter case, the following wastewater generation sources were identified:

Machine Shop:	500 m^3/year
Electrical Shop and Electronics Department:	125 m^3/year
Galvanizing Plant:	10 m^3/year
Acetylene Producing Plant:	1200 m^3/year
Motor Plant Repair Shop and Pipe-Workers Shop:	151 m^3/year
Boiler Shop:	1000 m^3/year
Docks Operations:	4000 m^3/year

Most of the separate streams of effluents are currently discharged through two main outlets for marine discharges leading from the Cleaning Bay of the Machine Shop. They discharge wastewaters into French Creek along what is sometimes called Factory Wharf. No algal growths were observed in the immediate vicinity of these outlets (*probably* because of the toxic effects of the effluents). Furthermore, there is evidence of considerable deposits of sludge in the area, since when seawater is agitated (as a result of dock activities or ship propellers) then the water in the area becomes murky with re-suspension of such sludge. MS has recently claimed that these two main outlets are no longer in operation.

As determined in 2000, various dock operations such as hull blasting, tank cleaning, hull washing and boiler cleaning generated approximately 4000 m^3/year. This volume may change depending on the level of operations of this industrial sector. Such wastewaters as arising within docks are eventually washed into the sea when the docks are flooded.

Axiak and Delia (2000), and Axiak (2003) have reported on the chemical profiles of some of these discharge streams (mainly dock waters and effluents arising from the acetylene production plant) as arising from MS and as monitored during two relatively short periods in 1999 and 2002. More recently the Environment Protection Directorate had monitored some of theses discharge streams in January 2003. All these results were made use of for the computation of the present BB arising from MS.

Much less information is available on the other shipyards. Indeed, the smaller shipyards of Bezzina and Cassar, are both claiming that they do not have any direct marine discharges arising from their yards (even though these wastewaters may be reaching the shoreline from diffuse sources located within the respective shipyard). For the purpose of the present BB computation, the estimated figures for annual discharge volumes arising from these yards as originally determined by Axiak and Delia (2000), have been used.

Due to the complex and variable nature of the industrial operations within this sector, as well as to the very limited data available, it is quite likely that the resultant BB as may be computed at this stage is quite unreliable and has to be validated in the second phase of the NAP, through more extensive and reliable data. In fact, in the opinion of the present author, the resultant BB for heavy metals and for some organic solvents are more likely to be underestimated.

Nonetheless a number of relevant observations may be made on the resultant BB for this sector. For example, releases from this sector of both cadmium and butyltins when expressed as a percentage of the national BB for the respective pollutants, feature most prominently. In absolute terms, the BB of releases of a range of heavy metals as well as of nutrients and of biodegradable organic material are also appreciable.

3.8 Other Industries

Axiak and Delia (2000) had identified at least four other direct marine discharges arising from industrial complexes. These included a pig farm, a food processing company and the location for Malta Film Facilities.

Furthermore, the inventory includes the industrial and sewage wastewaters which originate from Hal Far Industrial Estate and which are presently being discharged directly into the sea. This industrial estate is one of the largest in Malta and by 2000 had 59 industrial units. This amount will shortly increase. Little or no data is available on the chemical profile of the wastewaters generated from this area. However it may be assumed that this water will contain the same List 1 substances as would be expected in untreated sewage and industrial wastewaters currently being discharged from the official public sewer outfalls. It was expected that this discharge would be diverted to the public sewers by 2003.

It is most likely that other direct marine discharges from coastal industrial establishments exist. While these are more likely to be small in scale, they will need to be properly assessed in the second phase of the NAP. No data on the chemical profiles are available on any of these land-based sources.

In the case of discharges from the Malta Film Facilities, it is quite likely that only minimal release of pollutants (e.g. possibly traces of oils) would occur as a result of its operations. Therefore the computed BB for this sector does not take into account such releases from this land-based source.

In absolute terms, the BB of releases of nutrients, biodegradable organic materials, suspended solids, and oils (especially greases and oils of biogenic origin) for this sector are quite significant. This is because two of the four industries assessed in this sector were a major pig farm on the island of Comino as well as a food processing plant.

3.9 Marine Discharges from Public Sewers

As was already pointed out in Section 3.1, the national sewer systems collect both domestic and industrial wastewaters, and therefore we are not able to distinguish between the two when computing BB based on releases from sewers. Nonetheless it pertinent to point out that:

- Most local industries discharge their wastewaters into the public sewers, while very few have direct marine discharges which may be assessed separately. As such, if the national BB would exclusively include only those point sources of discharges which are strictly industrial in nature; in the local context, it would mean that we would not be considering the releases of pollutants from the majority of local industries.

- Such discharges are controlled by Legal Notice 139 of 2002 (Sewer Discharge Control Regulations, 2002) in order to reduce the levels of biodegradable organic matter, nutrients as well as suspended solids in addition to other chemicals which may damage sewers as well as the receiving treatment plant or the marine environment, after being discharged through sewage outfalls. Unfortunately, as yet, the level of compliance of local industry with such official controls, is low. Therefore it may be assumed that a significant proportion of the loads of relevant pollutants such as heavy metals and POPs being currently released into the marine environment from sewage outfalls, are in fact originating from local industrial sectors.

Full details have been provided about the chemical characteristics of local sewage, in the NDA report. The present BB for this sector is based on such data. Furthermore, separate BBs f releases for each respective pollutant were computed for the different public sewage outfalls. Table 1 however represents the total BBs for all combined outfalls.

As would be expected from the relatively high volumes of discharges of sewage and wastewaters from the main outfalls, as well as from the fact that most industries release their wastewaters into the public sewer, most (and in some cases, all) of the loads of releases for many contaminants originate from such sewers. **Table 2** gives an indication of the % load carried by sewers for the various pollutants being released from land-based sources in Malta.

Table 2: Percentages of total release of different pollutants as carried by public sewers, for both scenarios as described in text.

Best-Case Scenario

Mercury (and organomercuric)	100.00
Polychlorinated biphenyls	100.00
Trichloroethylene	100.00
Cyanides	98.44
BOD5	96.11
COD5	95.70
Total Suspended Solids	95.48
Total Nitrogen (inc nitrites, nitrates, ammonia)	94.71
Tin	92.75
Total Oil (including grease and persistent PHC)	91.66
Perchloroethylene	89.98
Total Phosphorus	87.01
Copper	78.28
Chromium	76.44
Fluorides	72.64
Lead (and organolead)	72.08
Petroleum Hydrocarbons (more volatile components)	62.89
Butyltin compounds	45.40
Zinc	44.50
Arsenic	43.74
Cadmium	14.58
Nickel	14.28
Boron	6.32
Chloroform	3.99
Selenium	0.10

Worst-Case Scnario

Mercury (and organomercuric)	100
PCB	100
Trichloroethylene	100
Cyanides	99.6
Perchloroethylene	98.77
Copper	95.47
Total suspended solids	95.18
BOD5	95.12
Tin	94.9
COD5	94.53
Total Oil (including grease and persistent PHC)	93.91
Total Nitrogen (inc nitrites, nitrates, ammonia)	93.41
Lead (and organolead)	87.59
Chromium	87.26
Zinc	83.4
Butyltin compounds (and other organotin compounds)	82.66
Petroleum Hydrocarbons (more volatile components)	80.3
Total Phosphorus	78.61
Arsenic	75.89
Fluorides	74.53
Nickel	53.07
Cadmium	34.91
Chloroform	29.32
Boron	13.66
Selenium	0.892

All of the categories of pollutants which were identified as being released by the other sectors, were also found in public sewers. Furthermore,10 to 12 of such pollutants (out of the 25 named pollutants) were either exclusively found in sewers or were at a level which is 90% or more of the total national BB for all sectors. These include the SAP-targeted pollutants, mercury and polychlorinated biphenyls.

On the other hand, some heavy metals notably cadmium and selenium as well as organics such as chloroform, were more released by the other exclusively industrial sectors, than by the public sewers.

With respect to petroleum hydrocarbons (not of biogenic origin), the sewers released 63% (best-case scenario) to 80% (worst-case scenario) of the total national loads.

It is to be noted that a substantial number of SAP-targeted pollutants such as many POPs have not been detected in local discharged wastewaters since their use is strictly controlled or prohibited.

One major source of uncertainty in the computation of the national BB turned out to be the lack of accurate data on the rates of discharge of wastewaters from public sewers. Unfortunately the Drainage Department was unable to comply with our repeated requests for such data, for the purpose of the present report. This issue will need to be addressed in the second phase of the NAP.

3.10 Hotels and Recreation Establishments

The inventory includes direct marine discharges of 10 hotels and one marine attraction. None of these discharges are likely to have any List 1 substances. Other direct marine discharges are known to arise from other coastal hotels. Some of these have been tentatively included in the inventory. These have still to be assessed. But they are again unlikely to contain List 1 substances. Information on the location of such discharge points have been included the NDA report.

Moreover we do not have any data on the chemical characteristics of such discharges. It was therefore decided not to include this sector in the national BB at this stage.

3.11 Other Unidentified And/Or Diffuse Sources

There are bound to be several other point sources of marine discharges from small or micro industrial plants such as car-repair garages, small furniture or joinery works, small jewellery workshops and others. While most of such micro-industries would be expected to release their wastewaters into the public sewers, there may be others (especially along the coast) which do not. The cumulative amounts of pollutants from such as yet unidentified sources may be appreciable.

Furthermore, as pointed in the NDA report, there is a large number of animal husbandry farms which are known to release large loads of nutrients and biodegradable organic matter. Such farms are legally bound to release their wastewaters into the sewers after proper treatment, but it is common knowledge that this is not always the case. Furthermore, there are other farms which may release their liquid wastes directly or indirectly (such as via valley courses) into the sea.

BB for such unidentified and/or diffuses sources may not be computed at this stage. Nonetheless, attempts to quantify the resultants releases of nutrients (nitrogen and phosphorus) from these and other inland activities (which were not taken into account in the present report) have been made in the NDA report.

4. Conclusions

The present report presents a national Baseline Budget of emissions/releases for the SAP targeted (and other) pollutants covering all locally significant land-based sources. This is being done within the framework of the implementation of the Strategic Action Programme (SAP) adopted by the 12th Meeting of the Contracting Parties to the Barcelona Convention.

This BB together with a National Diagnostic Analysis (NDA) should form the starting point for the eventual formulation and implementation of a National Action Plan (NAP) for Malta for the reduction and elimination of land based pollution.

The introduction of a national BB within the NAP and SAP operational strategy will enable the competent authorities to assess in an objective manner the degree of progress achieved as a result of the implementation of the NAP towards achieving stated quantitative targets in the reduction of specific pollutants or classes of pollutants. This is in fact the official reason for compiling such a BB report.

Nonetheless, during the compilation of such a report as well as in the process of computing of the relevant BBs, it soon became evident that there were other beneficial results, which may in the short-term be of greater relevance to the local context. These include:

- The generation of a comprehensive (if indeed only preliminary) picture and overview of how the various land-based activities are affecting our marine environment through the release of pollutants;

- The identification of specific gaps in our data and knowledge, which need to be remedied in a satisfactory manner during the next phase of the NAP, if Malta is to comply with its international obligations, and more importantly, if we are to manage such risks of marine contamination in a way so as not to jeopardize the long-term sustainable development of our coastal and marine resources.

The national BB for each specific pollutant or class of pollutants was originally to be computed according to guidelines as prepared by UNEP/MAP (2002). Such guidelines stipulated the estimation of the annual release of each pollutant from each industrial source on the basis of level of industrial output, manner of operation and the application of emission factors (EF) and subsequently the computation of total national BB for the respective pollutant for all industrial sources on an annual basis.

However due to a number of reasons as identified in the introduction section to the present report, a different methodology was finally adopted which involved an 'end of pipe' and 'source oriented' strategy for the compilation of the BB rather than 'load oriented' approach, through the application of EFs. This means that in most cases, the BB for a particular pollutant will be computed on the basis of data on concentrations of such pollutant in the various wastewaters released from identified point sources of discharges, as well as on the annual flow rates of such discharges. This strategy was approved by UNEP/MAP.

The limitations of the adopted methodology were also identified and assessed in Section 1, and these have to be taken in full consideration when reviewing the results of the present report. Such limitations have to be successfully addressed in the next phase of formulation and implementation of the NAP, if its aims and stated objectives are to be attained.

In complying the present national BB, full use was made of an inventory of marine discharges that the present author has compiled for the Environment Protection Directorate. In fact, the BB was computed for the various categories and industrial sectors as have been identified in such an inventory. Further details on this inventory and on its component discharge points have been included in the NDA report.

Due to the level of uncertainty in the quality of data as has been identified above, it was deemed opportune to adopt a best-case and a worst-case scenario in the estimation of the BB for each individual point source of discharge. In this way, it was possible to give an indication of the level of uncertainty for the quoted BBs.

In general, public sewers (which include domestic as well as industrial liquid wastes) were found to carry the highest loads of releases of SAP-targeted and other pollutants into the marine environment.

As expected, the chemical characteristics and the resultant BB for specific industrial sectors was generally determined by the nature of the operations involved, so that for example, while the fish farming sector released significant amounts of nutrients, suspended solids and biodegradable organic matter, the shipyard sector released mostly a range of heavy metals and other industrial organics. The main features of the BB for each sector have been briefly reviewed above.

To conclude, this BB is to be considered as a first step in the quantification of releases of relevant pollutants from local land-based sources and activities. It should be considered as a preliminary starting-point for further verifications, data generation and data collation in the next phase of the NAP.

5. References

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