Caribbean Environment Programme

United Nations Environment Programme

UNEP

Intergovernmental Oceanographic Commission

Environmental Quality Criteria for Coastal Zones in the Wider Caribbean Region

- A Compilation -

Prepared in co-operation with:

United States

Environmental Protection Agency (EPA)

CEP Technical Report No. 14

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ENVIRONMENTAL QUALITY CRITERIA FOR COASTAL ZONES IN THE WIDER CARIBBEAN REGION

SUMMARY

The Wider Caribbean Region comprises 35 States and Territories, with a great diversity of species in tropical ecosystems such as coral reefs, mangrove swamps and seagrass beds in its coastal zones, though not abounding in biotic wealth in its deep-water zones (due to the lack of upwelling and the narrowness of the continental shelf). The region is faced with an urgent need for effective environmental quality criteria for its coastal areas, which receive significant impact from numerous rivers that drain into them (e.g. the Mississippi and the Orinoco), the many industrial and urban settlements along the upper reaches of these rivers and along the coasts, and the lack of policies for environmental protection.

Information received from 18 of the 35 Focal Points of the CEPPOL Programme indicates differences in both conceptual and operational environmental quality criteria and parameters. In Aruba, World Health Organization (WHO) and Dutch standards are observed; Barbados emphasizes chemical parameters, for which it has established a water classification system. Belize does not have numerical criteria, but does use a normative system with reference to pollution. In Colombia, besides the conventional contaminants, 141 substances of sanitary interest have been listed, and water-quality criteria and effluent emission standards have been established for various uses. Costa Rica has national standards for bacteriological quality of its coastal waters, following an epidemiological study of the region; Cuba has established ranges for closed zones and open waters for conventional contaminants, including some heavy metals; in Dominica, environmental standards have not yet been adopted; Haiti is developing these standards, but at the moment they are not available; the United States Environmental Protection Agency (EPA) has developed a criteria for several non-conventional contaminants; the Cayman Islands perform periodic follow-ups on physical-chemical parameters under guidelines given by the WHO; the U.S. Virgin Islands utilize U.S. EPA criteria; Mexico has drawn up quality criteria for coastal waters for 88 parameters, divided into seven qualities, and has made advances in the field of toxicity bioassay. Panama has defined various parameters without indicating a numerical value for them, and makes reference to Brazil, Guatemala and Peru in the establishment of its criteria. Trinidad and Tobago uses a combination of standards from the EPA, the European Economic Community (EEC) and the WHO. The French Overseas Departments of Guadeloupe and Martinique have adopted the EEC standards; Jamaica

uses the standards set by the US EPA and WHO, while Venezuela has adopted its own legislation and St. Kitts and Nevis subscribe to the PAHO criteria.

Environmental-quality criteria may be qualitative or quantitative and a satisfactory combination of the two, depending on the existing level of specific knowledge, results in a more efficient formula for environmental action.

Quantitative criteria are expressed by physical, chemical and biological parameters or indicators, and to date have permitted the definition of 126 "priority contaminants" (EPA). Biological parameters reflect conditions which are of longer duration or temporal and statistical representation; in the field of bioassay and bio-indicators, considerable progress has been made, though ecosystem complexity and limited knowledge of the range of variables have limited this progress. One must also include indices of abundance, trophic diversity and composition, biomass and sediment quality.

Methodologies have been suggested (EPA, 1988) for the definition of Water Quality Criteria by means of an evaluation of the chronic and acute toxicity to aquatic animals; a comparison of this toxicity with that of marine plants and a review of bioaccumulation, which result in standards for the least biologically important value and continuous concentration allowable. The World Health Organization recommends that the upper limits for indicator organisms be expressed in global terms of order of magnitude rather than by a specific numerical limit; Salas (1985) indicated that the microbiological standards can be expressed as an average allowable concentration, and with a maximum value which should not exceed a given percentage over time (90% is usual).

The simple adoption of a particular group of standards is inappropriate without a careful review of the local/national social and economic circumstances and effects of the pollution encountered. Recent studies indicate relationships between faecal and total coliforms different from those conventionally accepted. Enterococci seem better related to instances of illnesses caused by ingestion and contact with water than do the coliforms. Laboratory bioassay should be validated by means of a systematic follow-up on bioindicators. All the above indicate the need to strengthen the coordinated task of the competent authorities in the search for efficient, effective environmental quality criteria and parameters for coastal waters, resulting in increased well-being and sustainable development in the Wider Caribbean area.

I. INTRODUCTION

1. Within the goals of the Caribbean Action Plan several activities, aimed at the control of marine pollution, have been carried out. The results of that work have been published in documents such as: "El Estado de la Contaminación Marina en la Región del Gran Caribe" (PNUMA-CEPAL, 1980), "El Desarrollo y el Ambiente en la Región del Gran Caribe: Una Síntesis" (Informes y Estudios del Programa de Mares Regionales No. 14 PNUMA-CEPAL", 1982), and more recently, the "Curso Regional de Entrenamiento sobre Ensayos Biológicos y Pruebas de Toxicidad, como Bases Técnicas para Formular un Criterio de Calidad de Aguas en el Gran Caribe" [PNUMA-PAC/CO/FAO/INDERENA/CIOH (Cartagena, 1989)].

2. The present document was prepared with the co-operation of the participants attending the workshop on Environmental Quality Criteria and Effluent Guidelines convened in San Juan, Puerto Rico, 5-15 November 1990. The document consists of a compilation of the environmental quality criteria and primary and secondary standards currently in existence in countries of the region that sent in data pertinent to the coastal and marine zones of their respective interest. It includes a brief discussion of the advantages, feasibility, desirability and applicability of those standards.

3. The purpose of this document is to contribute to the process of development of an environmental quality criteria to scientifically address the ecological, cultural and socio-economic conditions of the Wider Caribbean region, which is a tropical and therefore diverse environmental area.

4. The idea of producing this document was to provide the experts attending this workshop with a working paper describing the environmental quality adopted by the States and Territories of the Wider Caribbean region and to point out similarities and differences aimed at improving the environmental quality criteria for coastal waters of the Wider Caribbean.

5. The CEPPOL Focal Points were asked to submit the criteria on standards currently in use in the respective countries. To date, 18 countries have complied with the request, namely: Aruba, Barbados, Belize, the British Virgin Islands, Cayman Islands, Colombia, Costa Rica, Cuba, Dominica, France (Guadeloupe and Martinique), Haiti, Jamaica, Mexico, Panama, St. Kitts and Nevis, Trinidad and Tobago, the United States of America and Venezuela.

II. BASIC DEFINITIONS

6. Criteria: Value levels based on the best existing objective and scientific information.

7. Environmental Quality: The definition of the physical, chemical and biological levels, indicators above or below, in which an environment does not serve the social function or use - current or future - to which it is assigned or expected to serve.

8. Water Quality Standard: A set of regulations relating to the use(s) of a body of water or part of a body of water, plus those water-quality criteria necessary for protecting the use(s) of a specific body of water.

9. Water-Quality Criteria: Decisions as to the compliance or non-compliance of a body or source of water (current, reservoir, swamp, lake, coastal area, etc.) with the physical, chemical and biological requirements for a determined social purpose or function. Generally, these are the result of the examination of quantitative and/or qualitative exposure-effect relationship, based on scientific evidence between the water-quality indicator involved and the potential risks to human and/or environmental health and well-being associated with the uses of that water.

10. Effluent Guidelines: Regulations related to the physical, chemical and biological characteristics of waste waters that will be discharged in a water body or by infiltration. The selected standards will depend on the environmental quality expected for the receiving waters.

11. Coastal Region: A region adjacent to the coast containing water whose salinity exceeds 0.5/1000, including ecosystems such as mangrove swamps, coastal lagoons and the estuary zones extending to the edge of the continental shelf or, in the case of islands, areas comparable to the above described, (that is, which may also include ecosystems such as seagrass beds and coral reefs).

III. BACKGROUND

12. Environmental quality criteria for coastal waters are based on two major considerations: Human health (illness directly related to the ingestion of water or to contact with water) and the maintenance of biodiversity and of the physical and chemical characteristics of the coastal waters on behalf of various actual and potential uses.

13. Another fundamental concern in the case of the Wider Caribbean is the importance of its coastal zones and, therefore, of their ecosystems. This concern is associated with factors such as the various countries' national limitations with regard to systems for pollution control, the satisfactory use and management of territorial areas, etc.

14. More specifically, definition and precision in physical, chemical and biological criteria is advantageous and desirable for the delimitation of margins of the ecosystem tolerance and the margins of safety for human health.

Table 1. Current Conditions of Environmental Actions Towards Sustainable Development.[1]

Indicator Parameters	Industrialized Countries from Temperate Regions[2]	Pre-industrialized Countries from Tropical Regions[3]
Biotic features:		
-Biodiversity	Moderate, average and high in some locations	Average and very high
-Level of knowledge	Sufficient and broad	Partial and low
-Research and Development	High and integrated into the economy	Low marginal to the economy
-Information and Communication	High and fast	Low to average and slow
Socio-Cultural features:		
-Citizen participation	Established and normalized	Limited but growing
-Quality of life	Average to high	Average to low
-Energy consumption and waste	High but decreasing	Low to average
-Dependence on natural resources	Average to moderate	High
International features:		
-Environmental Institutions	Well established	In formation and weak
-Participation in Decisions	Timely	Occasional and late
-Intersectorial Co-ordination	Well established	Moderate and growing
-Budgetary limitations	Moderate, relative	High and significant
-Uncertainty in Decisions	Moderate, acceptable	High and significant

1/ In the preparation of this table, broad generalizations were made which may not be valid in some individual cases.

2/ Market economy countries of the Western Hemisphere.

3/ Mainly countries of the humid tropic of the Wider Caribbean Region.

Table 1 (Cont.)

Indicator Parameters	Industrialized Countries from Temperate Regions	Pre-industrialized Countries from Tropical Regions
Economic features:		
-Foreign debt	Low, manageable but growing	High and critical
-Technological Dependence	Moderate, balanced growth	High and critical
-Urgency to generate income	Moderate and stable	High and critical
-Control of international trade	Highly concerted	Insignificant

Table 2. New Perspective on Environmental Actions for Sustainable Development.

CURRENT PERSPECTIVE	NEEDED PERSPECTIVE
Remedial	Preventive
Mitigatory	Alternative
Conventional	Innovative
Fragmented/By Sector Vested Interests	Integrated/Cross-sector/Cooperative
Specialized	Interdisciplinary
Centralized	Municipal/Local
Slow/Delayed	Timely
Complaint/Diagnostic	Proposal
Marginal	Integral
Pollution control	Sustainable use

15. Aquatic ecosystems can, like other ecosystems, tolerate a certain degree of stress, as well as occasional damage. Additionally, from a realistic and practical standpoint, it is impossible to protect all species in all places all the time. This is possible when an acceptable level of information is available for enough taxa that an appropriate variety of functional taxonomic groups, a reasonable level of protection will probably be provided, if all but a small fraction of the taxa are protected unless in a particular zone where species which by virtue of some special or unique characteristics deserve to be specifically protected.

16. There is enough information on the relationship between water pollution and its effects on human health by way of various direct or indirect paths provided by the ecosystems (bioaccumulation, direct infection or contagion, etc.). However, more efforts will be required, not only to enforce the application of quality criteria, but also to update them to protect human health.

17. Additionally, we are more aware that as the environment deteriorates, opportunities for future use and development decline, since potential resources for development are eliminated or significantly decreased. The statement which held that the phrase "environment or development" included mutually exclusive alternatives is now obsolete, since what is now suggested is truly sustainable development. (Tables 1 and 2).

IV. GEOGRAPHIC AND ENVIRONMENTAL CHARACTERISTICS OF THE WIDER CARIBBEAN REGION

18. The Wider Caribbean Region is composed of the following States and Territories: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, the Cayman Islands, Colombia, Costa Rica, Cuba, Dominica, the Dominican Republic, France, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Turks and Caicos Islands, the United States and the US and U.K. Virgin Islands, Venezuela, the Netherlands, and the United Kingdom.

19. The marine component of the Wider Caribbean is a partially enclosed body of water. Average depth is more or less 2,200 meters, the deepest point being the Cayman Trench (7,100 m). The total surface area is approximately 4.24×10^6 km^2 (1.60×10^6 km^2 in the Gulf of Mexico and 2.64 x 10 km in the Caribbean. Therefore, the total volume of water is approximately 9.3×10^{18} liters. In comparison, the Mediterranean contains some 3×10^{18} liters (UNEP/ECLAC, 1989).

20. The most outstanding hydrographic characteristic of this area is the east-to-west circulation of water in the Caribbean, followed

Table 3. Rivers Draining in the Wider Caribbean

River	Drainage Area Km^2	Average Flow M^3/sec
USA		
Appalachicola (Florida)	44,000	620
Mobile (Alabama)	97,000	1,500
Mississippi	3,268,000	18,400
Brazos (Texas)	114,000	116
Colorado	107,000	79
USA - MEXICO		
Rio Grande	467,000	23
MEXICO		
Panuco	66,300	549
Grijalva	36,300	723
Usumacinta	47,700	1,763
GUATEMALA-HONDURAS		
Matagua	16,600	252
HONDURAS		
Ullua	22,500	526
Patuca	25,600	825
HONDURAS - NICARAGUA		
Coco	26,700	950
NICARAGUA		
Rio Grande de Matagalpa	19,700	762
NICARAGUA - COSTA RICA		
San Juan	38,900	1,620
PANAMA		
Changuinola	2,745	204
COLOMBIA		
Magdalena	235,000	7,500
Atrato	35,000	4,900
Sinu	4,200	700
VENEZUELA		
Orinoco	950,000	30,000

by a southeast-to-northwest movement into the Yucatan Basin and, finally reaching the Gulf of Mexico, eastward again through the Florida Straits. During certain months of the year, large eddies are formed along the coasts of Costa Rica, Panama, Colombia and certain parts of the Gulf of Mexico (UNEP/ECLAC, 1980).

21. The surface temperature in the tropical and southern parts of the Gulf of Mexico averages 27^{0}C, with seasonal variations no greater than 3^{0}C. In the southern zone, the temperature varies from 16^{0}C in the Winter, to 28^{0}C in the Summer. The cooler temperatures range from 10 to 15^{0}C in the first 200 meters, below which level there is only a very slow temperature decline (UNEP/ECLAC, 1980).

22. Atwood (1977, quoted in UNEP/ECLAC [1980]), after analyzing data on dissolved oxygen, temperature and silicates, concluded that, "it appears there has not been any great renewal in the deepest areas of the Caribbean", and that, "it is not easy for the contaminants entering these waters to leave them, possibly creating conditions of anoxia".

23. The Caribbean region contains the drainage basins of 18 important rivers, among which are two of the largest in the world, the Mississippi and the Orinoco (Table 3). Although the Orinoco is outside the Caribbean, it must be taken into account because of the large current which circulates in a northeasterly direction along the coast of Venezuela and picks up and carries most of the waters emptied into the ocean by the Orinoco. The influence of more southerly rivers (e.g. the Amazon, which empties four to five times more water into the ocean) has not been quantified, but there is no doubt that its contribution to the hydrography of the Caribbean is considerable. It is important to give special attention to the contaminants carried by rivers, since the contribution of rivers to the waters of the Caribbean is approximately 0.5 x 10^7 M^3/sec., in comparison with the 3 x 107 M^3/sec. entering the Caribbean through the channels of the Lesser Antilles. According to WHO/UNEP, among the above-mentioned rivers, the Magdalena discharges 220 million tons of sediments into the Caribbean per year, while the Mississippi and the Orinoco discharge 210 and 150 million tons of sediments, respectively.

24. The Caribbean Region does not have a wide, shallow continental shelf. On the other hand, the temperature of the water does not fluctuate very greatly, the thermocline being relatively stable and therefore not allowing superficial and deep waters to mix. Although there are important areas of upwelling, these do not constitute an important characteristic of the region. As a result, the supply of nutrients is restricted. Thus we may see the profound importance of the coastal zone in which there is great biodiversity: areas of the Gulf of Mexico, the Bay of Campeche, and South America are host to important commercial shrimp fisheries, these being associated with shallow waters, mangrove swamps, estuaries and coastal lagoons. One sees, therefore, the

importance of the role played by coastal ecosystems and the need to protect them from destruction and/or pollution (UNEP/ECLAC 1980).

25. Generally speaking, the Wider Caribbean region shares many of the South American sub-continent's cultural and natural characteristics, difficulties and potentialities. In proportion to the high level of coastal biodiversity, knowledge concerning it is limited and marginal; institutions in charge of natural resources and the environment are weak in relation to others in the area; the role played by society as a whole and by these institutions in particular regarding decisions on development projects, is small, though growing; the speed of resource degradation is high and in some cases accelerating. The problem of the foreign debt in many countries of the region does not allow for environmental protection or research on natural biotic resources to be given high priority.

26. Given this general scenario in which the predominant "environmental" perspective has been remedial, marginal, centralized, piecemeal and in general too late, what is required are innovative, alternative, decentralized, participatory and integrated environmental responses.

27. In the case of the coastal zones, this view of the situation has led to a suggestion that we need to become "miners" of the biological wealth, to become ocean farmers, and this requires us to re-evaluate the natural resources of our coasts and to adopt a more united and visionary attitude; one of solidarity in confronting the effects by which pollution from the land affects mainly the coastal regions.

V. ENVIRONMENTAL QUALITY STANDARDS AND CRITERIA IN THE REGION OF THE WIDER CARIBBEAN

28. Below are detailed environmental quality standards and criteria for coastal areas in the region of the Wider Caribbean, compiled from information furnished by the countries of the region. Table 4 summarizes the water quality standards and criteria for some uses in five countries (Mexico, Cuba, Colombia, the United States and Venezuela), while Table 5 summarizes some bacteriological standards and criteria for the waters of several countries and world regions, so that one may compare the values established for other latitudes with the values in use in some of the countries of the Caribbean region. The information, provided by 18 States and Territories of the Wider Caribbean Region, is described as follows:

ARUBA

29. Aruba is in the process of developing new environmental laws which will include water-quality standards. Up to now, they have

employed Dutch standards and those of the World Health Organization as general guidelines. They have a Department of Environmental protection. Aruba is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

BARBADOS

30. Barbados has a Coastal Conservation Unit, which carries out bimonthly sampling of coastal water-quality evaluation. These are based on the work of Srinavasan (1981), Sander (1971), and Meynell (1982) on the quality of coastal waters south and west of the island. Barbados employs the sampling methods recommended by the "Standard Methods for the Examination of Water and Waste Water" (1985) of the American Public Health Association (APHA), and the American Water Works Association (AWWA). The Ministry of Public Health, through the Division of Environmental Engineering, monitors the sewage treatment plants of the hotels.

31. The Coastal Conservation Unit takes samples at 18 locations on the most heavily visited recreational beaches, distributed along the southern and western coasts of the island. The samples are taken from 30 to 50 meters offshore, since this is the area most used for recreation. The follow-up programme has only been functioning for about a year, and great emphasis has been placed on chemical parameters. Results to date show that the standards have not generally been exceeded, except in some locations, as a result of pollution by catchment areas and land drainage.

32. Although the Coastal Conservation Unit is the entity which performs the measurements, it is really the Ministry of Health that has the regulatory authority.

33. The basic standards in use seek to preserve the quality of coastal waters and that of the coral reefs, and for that purpose a classification of water usage has been adopted. This consists of three large classes as follows:

Class 1. Waters for oceanographic research, conservation of the coral reefs, support and propagation of marine life; compatible recreation including fishing, swimming and bathing, and water sports; and aesthetic appreciation.

Class 2. Support and propagation of marine life; compatible recreation, including fishing, swimming and bathing and water sports; and aesthetic appreciation.

Class 3. Applies to very localized sites near ports and docks.

34. The environmental and conservation policies of Barbados are described in the Government's Development Plan for the 1988-1993 period (Nurse and Carvalho, 1989). Barbados is signatory to the 1983 Cartagena Convention for Protection and Development of the Wider Caribbean and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

BELIZE

35. Belize has a Ministry of Tourism and the Environment, and also possesses a set of qualitative regulations which define responsibilities in various areas such as the conduct of ships which come into port in Barbados (forbidding the dumping or throwing overboard of substances into the coastal waters) and certain aspects relating to water pollution and waste control generally (such as forbidding the installation of privies at or near the shore of the ocean, any river or channel).

CAYMAN ISLANDS

36. The Cayman Islands have a Natural Resource Unit, a Water Authority and a Department of Environmental Health that, in conjunction, are in charge of making periodic determinations of nine coastal water parameters. These parameters are dissolved oxygen, salinity, PH, temperature, Redox potential, conductivity, BOD and total and faecal coliforms.

COLOMBIA

37. Colombia has a relatively well-developed body of environmental legislation, a National Code of Natural Resources and Environment (Decree Law 2811, 1974). Several decrees relating to water quality (Decree 1594 of 1983), in which are defined the values for various physical, chemical and biotic parameters for various uses of water, along with the pollutant level permitted for domestic (municipal) and industrial effluent. In Decree 1594, values are set for coastal zones, as presented in Table 4. Besides the parameters and indicators conventionally accepted (e.g. BOD, COD, faecal coliforms, etc.), 141 substances of sanitary interest are identified, among which are heavy metals, chlorinated benzenes, dichlorobenzenes, chlorinated phenols including chlorinated cresols, haloesters, halomethanes, nitrophenols, nitrosamines, phthaloesters, aromatic polynuclear hydrocarbons, pesticides and their metabolites, DDT and its metabolites, endosulfane and its metabolites, heptachlor and its metabolites, benzene hexachloride, polychlorinated biphenyls, and other compounds.

38. For purposes of the application of the various quality parameters, seven types of water use are defined:

- Human and domestic consumption
- Preservation of flora and fauna
- Agricultural
- Livestock related
- Recreational
- Industrial
- Transportation related

For each of these categories, values for the various indicators or parameters are defined, according to a safety or risk criteria.

39. In the case of waste water effluents, separate values are established for new and existing users, given that it is very difficult to bring existing installations immediately into compliance with the new standards; and in some cases, the cost relative to activity may be critical, at least if the standards are imposed simultaneous instead of in stages. Therefore, a Compliance Plan for each industry has been provided, and in some regions of the country it has met with a good degree of success. Allowable pollutant levels are calculated by a series of equations contained in the decree. The decree likewise contains the percentage of allowable effluent, and a monetary value is assigned to any remaining level.

40. The methodology for sampling and analysis of effluent and water for consumption is taken from the APHA and AWWA manuals. There are also other decrees relating to questions of jurisdiction and legal authority over the control and surveillance of coastal and marine zones. These decrees define some aspects and standards. Although they do not quantify the quality with respect to the degree of responsibility of the ships for any damage to the environment, for example, they do deal in quantitative terms.

41. Colombia is signatory to the International Convention for the Prevention of Pollution from Ships (London, 1973) and its Protocol of 1978 (MARPOL 73/78). Colombia is also signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills Within the Region.

TABLE 4

WATER QUALITY CRITERIA AND STANDARDS USED BY SOME OF THE COUNTRIES OF THE WIDER CARIBBEAN REGION[1]

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Acenaphthalene	-	-	-	-	0.01 [a]	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Acenaphthene	-	-	-	-	-	-	-	-	970	710	1020	2700	-	-	-	-	-	-
Acroleine	-	-	-	-	0.005 [a]	-	-	-	55	-	320	780	-	-	-	-	-	-
Acrylonitrile	-	-	-	-	-	-	-	-	-	-	0.059	0.678	-	-	-	-	-	-
Aesthetic Aspects	-	-	-	-	d	-	-	-	-	-	-	-	-	-	-	-	-	-
Aldrin	-	-	-	-	0.001 [b]	-	-	-	1.3	-	0.00013	0.00014	-	-	-	-	-	-
Alfa Endosulfan	-	-	-	-	3E-5 [b]	-	-	-	0.034	0.0007	0.930	2.0	-	-	-	-	-	-
Alfa total (Bq/e)	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
Alkalinity ($C\ CO_3$)	-	-	-	-	±25% [c]	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminium Al	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	1.0	20	5	10
Ammoniac H_3N	-	-	$0.1\ LC_{50}^{96}$	-	$0.01\ N^{-3}$	-	0.1	-	-	-	-	-	-	-	-	-	-	-
Antracene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Antymony (Sb)	-	-	-	-	-	-	-	-	-	-	14	4300	-	-	-	-	-	-
Aromatic Polynuclear	-	-	-	-	0.1 [b]	-	-	-	300	-	-	-	-	-	-	-	-	-
Arsenic (As)	-	-	$0.1\ LC_{50}^{96}$	0.5	0.04 [b]	-	-	-	69	36	0.01	0.14	0.05-0.2	-	0.1	0.5	0.5	0.5
Asbestos	-	-	-	-	-	-	-	-	-	3000	fibers/L		-	-	-	-	-	-

Tabe 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Barium (Ba)	-	-	0.1 LC$^{96}_{50}$	5.0	0.5	-	-	-	-	-	-	-	-	-	5	0.1	5	0.1
Benzidine	-	-	-	-	-	-	-	-	-	-	0.00012	0.00054	-	-	-	-	-	-
Benzene	-	-	-	-	0.005^{b}	-	-	-	5.1	700	1.2	71	-	-	-	-	-	-
Beryllium (Be)	-	-	0.1 LC$^{96}_{50}$	-	-	-	-	-	-	-	0.0076	0.131	-	-	-	-	-	-
Beta Endosulfan	-	-	-	-	4E-5^{b}	-	-	-	0.034	0.0007	0.930	2.0	-	-	-	-	-	-
Beta total (Bq/e)	-	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-
BOD ppm O_2	-	-	-	Removal ≥ 80 %	-	-	-	-	-	-	-	-	20-100	-	<40	400	60	400
Boron (B)	-	-	-	-	0.009^{b,8}	-	-	-	-	-	-	-	-	-	-	1	-	1
Bromoform	-	-	-	-	-	-	-	-	-	-	5.7	470	-	-	-	-	-	-
Bromides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3
Methyl Bromide	-	-	-	-	-	-	-	-	-	-	40	4000	-	-	-	-	-	-
Cadmium (Cd)	-	-	0.01 LC$^{96}_{50}$	0.1	0.009^{b}	-	0.005	-	4.3	9.3	10	170	0.005-0.2	-	0.1	0.2	0.2	0.2
Carbamates	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.025	0.05
Carbon Disulfide	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Tetrachloride	-	-	-	1.0	0.5$^{a \& b}$	-	-	-	50000	-	0.25	4.58	-	-	-	-	-	-
2-Chloronaphthalene	-	-	-	-	-	-	-	-	7.5	-	-	-	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
2 Chlorophenol	-	-	-	-	0.1	-	-	-	-	-	120	-	-	-	-	-	-	-
Chlorophenol	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 Chlorophenol	-	-	-	-	-	-	-	-	29700	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethyl Vinyl E	-	-	-	-	-	-	-	-	-	-	0.032	18	-	-	-	-	-	-
Carbon Chloroform EEC	-	-	-	1.0	-	-	-	-	-	-	570	470	-	-	-	-	-	-
Chlorobenzene	-	-	-	-	-	-	-	-	160[1]	129	400	-	-	-	-	-	-	-
Chlorine Total	-	-	0.1 LC^{96}_{50}	-	0.0075[b]	-	-	-	13	1.5	-	-	-	-	-	-	-	-
Bis(Chloromethyl) E	-	-	-	-	-	-	-	-	-	-	1400	17000	-	-	-	-	-	-
Chlordane	-	-	-	-	9E-5[b]	-	-	-	0.09	0.004	0.00058	0.00059	-	-	-	-	-	-
Bis(2Chloroisopropyl)E	-	-	-	-	-	-	-	-	-	-	0.031	1.4	-	-	-	-	-	-
Chlorides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300	-	300
Chlorodibromomethane	-	-	-	-	-	-	-	-	-	-	5.7	470	-	-	-	-	-	-
Chlorophyrifos	-	-	-	-	-	-	-	-	0.011	0.0056	-	-	-	-	-	-	-	-
Chrome Cr^{+3}	-	-	-	-	-	-	-	-	-	-	33000	670000	-	-	2	5	2	3
Chrome Cr^{+6}	-	-	0.01 LC^{96}_{50}	0.5	0.05[g]	-	-	-	1100	50	170	3400	001-1	-	0.1	0.5	0.5	0.5

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organism	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Cianide (CN -)	-	-	0.05 LC_{50}^{96}	1.0	0.001 [h]	-	-	-	1	1	700	215 000	-	-	0.1	2	0.2	2
Cobalt (Co)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5
COD	-	-	-	-	-	-	-	-	-	-	-	-	30-200	-	<100	1000	350	1000
Color (Pt - Co)	-	-	-	-	j	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper (Cu)	-	-	0.1 LC_{50}^{96}	3.0	0.003 [h]	-	0.005	-	2.9	2.9	1300	-	-	-	0.5	3	1	3
Crysene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
DDD	-	-	-	-	4E-5 [a b]	-	-	-	-	-	0.00003	0.00003	-	-	-	-	-	-
DDE	-	-	-	-	0.000 [a b]	-	-	-	14	-	0.00059	0.000059	-	-	-	-	-	-
DDT	-	-	-	-	0.001 [b]	-	-	-	0.13	0.001	0.00059	0.000059	-	-	-	-	-	-
Deneton	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-
Dibenzo(ab) Antracene	-	-	-	-	-	-	-	-	-	-	0.002	0.311	-	-	-	-	-	-
2,4 Dichlorophenol	-	-	-	-	-	-	-	-	-	-	93	790	-	-	-	-	-	-
1,2 Dichloropropane	-	-	-	-	0.1 a	-	-	-	3400	10300	-	-	-	-	-	-	-	-
1,2 Tr Dichloromethylene	-	-	-	1.0	2.24 [b,k]	-	-	-	224000	224000	700	14000	-	-	-	-	-	-
1,3 Dichloropropilene	-	-	-	-	-	-	-	-	-	-	10	1700	-	-	-	-	-	-
1,2 Dichloropropilene	-	-	-	-	0.008 [a]	-	-	-	-	-	10	1700	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Dichloropropane	-	-	-	-	-	-	-	-	790	-	-	-	-	-	-	-	-	-
1,4 Dichlorobenzene	-	-	-	-	0.02	-	-	-	1.97	-	400	2600	-	-	-	-	-	-
1,3 Dichlorobenzene	-	-	-	-	0.02	-	-	-	1.97	-	400	2600	-	-	-	-	-	-
1,2 Dichlorobenzene	-	-	-	-	0.02	-	-	-	1.97	-	2700	17000	-	-	-	-	-	-
3,3 Dichlorobenzidine	-	-	-	-	-	-	-	-	-	-	0.048	0.077	-	-	-	-	-	-
1,2 Dichloromethylene	-	-	-	1.0	2.24[b,k]	-	-	-	224000	224000	700	140000	-	-	-	-	-	-
1,2 Dichloromethane	-	-	-	-	1.1[a,b]	-	-	-	113000	-	0.38	99	-	-	-	-	-	-
1,1 Dichloromethylene	-	-	-	1.0	2.24[b,k]	-	-	-	224000	224000	0.057	3.2	-	-	-	-	-	-
Dichlorodibromomethane	-	-	-	-	-	-	-	-	-	-	5.7	470	-	-	-	-	-	-
Dieldrin	-	-	-	-	0.0007[b]	-	-	-	0.71	0.0019	0.00014	0.00014	-	-	-	-	-	-
2,6 Dinitrotoluene	-	-	-	-	0.0059[b,l]	-	-	-	590	370	-	-	-	-	-	-	-	-
2,4 Dinitritoluene	-	-	-	-	0.0059[b,l]	-	-	-	-	-	0.11	9.1	-	-	-	-	-	-
Dinitro-O-Cresol	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2 Diphenilhidrazine	-	-	-	-	-		-	-	-	-	0.041	0.54	-	-	-	-	-	-
2,4 Dinitrophenol	-	-	-	-	0.05	-	-	-	-	-	70	14000	-	-	-	-	-	-
Diphenil	-	-	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Zones of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Dissolved Gases %	-	-	-	-	1.1 m	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3000	1200	1440	1200
DO % of saturation	70%	70%	4ppm	-	≥ 5ppm	75%	6ppm	-	-	-	-	-	> 3ppm	70%	-	-	-	-
Elemental Phosphorous	-	-	-	-	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan Sulfate	-	-	-	-	-	-	-	-	-	-	0.93	2	-	-	-	-	-	-
Endrin Aldehyde	-	-	-	-	-	-	-	-	-	-	0.76	0.01	-	-	-	-	-	-
Endrin	-	-	-	-	4E-5 b	-	-	-	0.037	0.0023	0.76	0.01	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	0.5	-	-	-	430	-	3100	2900	-	-	-	-	-	-
F.coliforms MPN/100ml	200	-	-	-	200	-	-	14j	-	-	-	-	100 - 1000	< 200	200	-	-	-
	-	-	-	-	90%<400	-	-	90% <43	-	-	-	-	-	-	XX<400	-	-	-
Floating materials	Absent	Absent	-	Absent	-	-	-	-	-	-	-	-	-	-	Absent	Absent	Absent	Absent
Benzo(a) Pyrene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Benzo(g,h,i) Perylene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
3,4 Benzo Fluorantene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Benzo(a) Antracene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Benzo(k) Fluorantene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	Protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Fluorantene	-	-	-	-	0.0004[a]	-	-	-	40	16	42	54	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Fluorides (F^-)	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	0.5	10	0.5	10
Grease and oil as D/S	Absent	Absent	0.01 LC^{96}_{50}	Removal ≥ 88%	-	-	-	-	0.01	-	-	-	5 - 20	< 0.5	< 30	100	20	150
Gution	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-
Halomethanes	-	-	-	-	-	-	-	-	12000	6400	-	-	-	-	-	-	-	-
Hardness	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-
HCB Alfa	-	-	-	-	-	-	-	-	-	-	0.039	0.013	-	-	-	-	-	-
HCB Beta	-	-	-	-	-	-	-	-	-	-	0.014	0.046	-	-	-	-	-	-
HCB Delta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HCB Gama	-	-		-	-	-	-	-	0.16	-	0.019	0.063	-	-	-	-	-	-
HCB	-	-		-	3E-6[a,b,e]	-	-	-	-	-	-	-	-	-	-	-	-	-
HCB Lindane	-	-	-	-	0.0002	-	-	-	0.16	-	-	-	-	-	-	-	-	-
Heptachlor Epoxide	-	-	-	-	-	-	-	-	0.053	0.0036	0.0001	0.0001	-	-	-	-	-	-
Heptachlor	-	-	-	-	0.0005[b]	-	-	-	0.053	0.0036	0.0002	0.0002	-	-	-	-	-	-
Hexachloro methane	-	-	-	-	0.009[a,b]	-	-	-	940	-	2	0.98	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organism	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Hexachloro Benzene	-	-	-	-	0.0016[j]	-	-	-	-	-	0.00072	0.00074	-	-	-	-	-	-
Hexachloro butadiene	-	-	-	-	0.0003 [b]	-	-	-	32	-	0.44	50	-	-	-	-	-	-
Hexachloro pentadiene	-	-	-	-	7E-5[a]	-	-	-	70	-	242	17400	-	-	-	-	-	-
Indene (1,2,3, c.d.) Pyrene	-	-	-	-	-	-	-	-	-	-	0.002	0.0311	-	-	-	-	-	-
Iron (Fe)	-	-	0.1LC$^{96}_{50}$	-	0.05	-	-	-	-	-	-	-	-	-	10	25	10	25
Isofurane	-	-	-	-	0.1 [a]	-	-	-	12900	-	6900	49000	-	-	-	-	-	-
Lead (Pb)	-	-	0.01LC$^{96}_{50}$	0.5	0.006	-	-	-	220	9.5	50	-	0.1-0.5	-	0.5	0.5	0.5	0.5
Malation	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-
Manganese (Mn)	-	-	0.1 LC$^{96}_{50}$	-	-	-	-	-	-	-	-	-	-	-	2	10	2	10
Mercury (Hg)	-	-	0.01LC$^{96}_{50}$	0.02	2E-5[b.g]	-	-	-	2.1	0.025	0.14	0.15		-	0.002	0.01	0.01	0.01
2 Methyl-4,6 dinitrophenol		-	-	-	-	-	-	-	-	-	13.4	765	-	-	-	-	-	-
Methyl Chloride	-	-	-	-	-	-	-	-	-	-	5.7	470	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	-	-	-	-	-	-	.7	1600	-	-	-	-	-	-
Metoxichlor	-	-	-	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-	-
Mineral Oils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 20	30	-	-
Mirex	-	-	-	-	-	-	-	-	0.001	-	-	-	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Zones of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Molluscs	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Naphthalene	-	-	-	-	0.02[a]	-	-	-	2350	-	-	-	-	-	-	-	-	-
Nickel (Ni)	-	-	0.01LC50 96	2	0.002 a	-	-	-	75	9.3	510	3800	-	-	2	0.5	2	0.5
Nitrogen Total	NE	NE	-	-	-		-	-	-	-	-	-	-		5-10	40	10	10
Nitrobenzene	-	-	-	-	0.07 a	-	-	-	66	-	17	1900	-	-	-	-	-	-
2 Nitrophenol	-	-	-	-	0.005 a	-	-	-	4050	-	-	-	-	-	-	-	-	-
4 Nitrophenol	-	-	-	-	0.005 a	-	-	-	4050	-	-	-	-	-	-	-	-	-
Nitrosamines	-	-	-	-	-	-	-	-	330000	-	-	-	-	-	-	-	-	-
Nitrates (NO_3^-)	-	-	-	-	0.04	-	2	-	-	-	-	-	-	-	-	-	-	-
Nitrites (NO_2^-)	-	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-
N-Nitrosodiphenylamine	-	-	-	-	0.0059[1]	-	-	-	-	-	50	16	-	-	-	-	-	-
N-Nitrosodimethylamine	-	-	-	-	0.0059[1]	-	-	-	-	-	0.00069	0.1	-	-	-	-	-	-
N-Nitrosodi-N-Propylamine	-	-	-	-	0.0059[1]	-	-	-	-	-	0.005	0.5	-	-	-	-	-	-
Organophosphorous pesticides active agent	-	-	0.05LC50 96	-	-	-	-	-	-	-	-	-	-	-	0.02	0.05	0.05	0.05
Organic Solvents	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Absent	-	-	-
Organic Mercury	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Zones of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Organochlorine pesticides active agent	-	-	0.05 LC_{50}^{96}	0.1	-	-	-	-	-	-	-	-	-	-	0.05	0.05	0.025	0.05
PCB - 1260	-	-		-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB - 1016	-	-	-	-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB - 1242	-	-	-	-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB - 1254	-	-	-	-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB - 1232	-	-	-	-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB - 1248	-	-	-	-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB - 1221	-	-	-	-	-	-	-	-	10	0.03	0.000044	0.000045	-	-	-	-	-	-
PCB's	-	-	-	ND	3E-5 [b]	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachloroethane	-	-	-	-	0.0005 [a]	-	-	-	390	281	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	0.0005 [a]	-	-	-	13	7.9	1000	29000	-	-	-	-	-	-
pH Units	5-9	5-9	6.5-8.5	5-9	± 0.2 [f]	7-8.5	7.5-9	-	-	-	-	-	6.9	6.1-8.9	6-9	6-9	6-9	6-9
Phenantrene	-	-	-	-	-	-	-	-	-	-	0.0028	0.0311	-	-	-	-	-	-
Phenols	0.002	-	1.0 LC_{50}^{96}	0.2	0.06 [a]	-	-	-	5000	-	21	4600	-	-		0.5	0.5	0.5
Phosphates $(PO_4^{3})^-$	-	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Borne of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organism	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Diethyl Phtalate	-	-	-	-	0.29 [I]	-	-	-	2944	-	2300	120000	-	-	-	-	-	-
Dimethyl Phtalate	-	-	-	-	0.29 [I]	-	-	-	2944	-	3130	290000	-	-	-	-	-	-
Bis(2 ethylbenzil)Phtalate	-	-	-	-	0.009[illegible] [I]	-	-	-	-	-	1.8	5.9	-	-	-	-	-	-
Butylbenzil Phtalate	-	-	-	-	-	-	-	-	-	-	3000	5200	-	-	-	-	-	-
Di-n-butyl Phtalate	-	-	-	-	-	-	-	-	2944	-	2700	120000	-	-	-	-	-	-
Settling Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	30
Salinity o/oo	-	-	-	-	-	12-14	27-35	23-28	-	-	-	-	-	-	-	-	-	-
Selenium (Se)	-	-	$0.01LC^{96}_{50}$	0.5	0.2	-	-	-	300	71	104	680	-	-	-	0.2	-	0.2
Silicates	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
Silver (Ag)	-	-	$0.01LC^{96}_{50}$	0.5	0.002	-	-	-	2.3	-	91	-	-	-	-	0.1	-	0.1
Sulfates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	400	-	300
Sulfides H_2S	-	-	0.0002	-	0.002	-	-	-	-	-	-	-	-	-	-	2	-	2
Suspended Solids	-	-	-	Removal	-	-	-	-	-	-	-	-	20-30	-	-	-	-	-
Suspended Matter that containt organisms	Absent	Absent	Absent	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tallium (T_l)	-	-	-	-	0.02 [a]	-	-	-	2130	-	2	7.2	-	-	-	-	-	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Norms of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
TDE	-	-	-	-	-	-	-	-	3.6	-	-	-	-	-	-	-	-	-
Temperature °C	-	-	-	≤ 40°C	± 15°C	18-34	26-30	15-30	-	-	-	-	±2.5°C	-	-	-	-	-
Tensoactive compounds	0.5	0.5	0.1 LC 96/50	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2,2 Tetrachloro ethanol	-	-	-	-	-	-		-	9200	-	-	-	-	-	-	-	-	-
1,1,2, Tetrachloroethane	-	-	-	-	-	-		-	-	-	0.6	42	-	-	-	-	-	-
1,1,2,2, Tetrachloromethane	-	-	-	-	-	-	-	-	-	-	0.17	11	-	-	-	-	-	-
2,3,5,6 Tetrachloro phenol	-	-	-	-	-	-	-	-	440	-	-	-	-	-	-	-	-	-
2,3,7,8 Tetrachloro dibenzo-P-Dioxin	-	-	-	-	1E-8 [b]	-	-	-	-	0.00001	-	-	-	-	-	-	-	-
2,4,6 Tetrachlorophenol	-	-	-	-	-			-	-	-	1.2	3.6	-	-	-	-	-	-
Tetrachloromethylene	-	-	-	1.0	0.02 [b]	-	-	-	10200	450	0.8	0.85	-	-	-	-	-	-
Turbidity that interfere with phothosynthesis	-	-	Absent	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	0.06 [a]	-	-	-	6300	5000	10000	300000	-	-	-	-	-	-
Total Phosphoruous	NE	NE	-	-	-	-	5	-	-	-	-	-	-	-	1	10	1	20
T.coliforms MPN/100ml	1000	5000	-	-	-	-	-	70j	-	-	-	-	-	-	1000	-	500	-

Table 4 (Cont.)

	COLOMBIA				MEXICO				U.S. EPA				CUBA		VENEZUELA			
	Recreation Primary Contact	Secondary Contact	Preservation Flora and Fauna	Zones of Discharge	protection Coastal Areas	Prawns	Aqua Shrimp	culture Mollusks	Marine Maximum	Water Criteria Continuous	Public Water and Organisms	Health Organisms	Closed and open Areas	Recreation Primary Contact	Lake Direct	Maracaibo Sewer	Fresh Direct	Waters Sewer
Toxaphene	-	-	-	-	2E-7[g]	-	-	-	0.21	0.0002	0.00073	0.00075	-	-	-	-	-	
Transparency	-	-	-	-	-	15-25	-	-	-	-	-	-	-	-	-	-	-	
1,1,1 Trichloroethane	-	-	-	-	0.3 [b.]	-	-	-	31200	-	31000	170000	-	-	-	-	-	
Trichloromethylene	-	-	-	1.0	0.02[b.]	-	-	-	2000	-	2.7	91	-	-	-	-	-	
Turbidity silica scale	-	-	-	-	±10% [c]	-	-	-	-	-	-	-	-	-	-	-	-	
Vanadium (V)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	25	5	
Vinyl Chloride	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zinc (Zn)	-	-	0.01 LC^{96}_{50}	-	0.09	-	-	-	95	86	-	-	0.1-5	-	2	2	2	2

1/ This table was prepared with information provided by Colombia, Cuba, Mexico, the United States of America and Venezuela. The concentration of the pollutants are expressed in mg/l (ppm), with the exception of the United States that are in ug/l (ppb). N.E. = No eutrophication and N.D. = Not detectable

(following Table 4)

a. The level of this substance was obtained by multiplying the acute toxicity reported by 0.01

b. The substance shows persistence, bioaccumulation, or risk of cancer; therefore, human exposure should be reduced to a minimum.

c. Variation in natural conditions.

d. The body of water should be free of substances attributable to waste water or other discharges which:

   1. Form deposits that adversely change the physical characteristics of the water;

   2. Contain floating material such as particles, oil, or other residues which give the water an unpleasant appearance;

   3. Produce color, odor, flavor, or turbidity; or

   4. Foster undesirable or unpleasant aquatic life.

e. Data given for HCB involve the mixture of alpha, beta and gamma isomers.

f. Acute toxicity for marine water organisms multiplied by 0.01 indicates that the concentration of esters of phthalic acid should not be greater than 0.02944 mg/l.

g. The four-day average concentration of this substance should not exceed this level more than once every three years.

h. The one-hour average concentration of this substance should not exceed this level more than once every three years.

i. The acute toxicity of chlorobenzenes for marine water organisms multiplied by 0.01 indicates that the concentration of chlorobenzenes (except dichlorobenzenes) should not exceed 0.00160 mg/l.

j. Suspended solids (including sedimentables), in combination with color, should not reduce the depth of the light compensation level for photosynthetic activity more than 10% above the natural value.

k. The acute toxicity of dichloroethylenes for marine water organisms multiplied by 0.01 indicates that its concentration should not exceed 2.24 mg/l.

l. The acute toxicity of dinitrotoluenes for marine water organisms multiplied by 0.01 indicates that its concentration should not exceed 0.0059 mg/l.

m. The total concentration of dissolved gases should not exceed 1.1 times the saturation value in prevalent hydrostatic and atmospheric conditions.

Table 5: **Microbiological Water Quality: Guidelines and Standars / 100 ml**

	Seafood	Harvest	Primary	Contact		Protection of Flora	Protection of Fauna	
Country	T. Coliforms	F. Coliforms	T. C.	F.C.	Others	T.C.	F.C.	References
U.S.A. (EPA)		14[a] 90% 43			Enterococci 35[a]			EPA (1976) (1986)
California	70c 90% < 230		80% < 1000	200				Cal. Ste Water Re. Board
Venezuela	70e 90% < 230	14 90% < 43	90% < 1000 100% < 5000	90% < 200 100% < 400				MARNR (1978)
Puerto Rico	70[a] 80% 230			200h				JCA of Puerto Rico (1983)
Peru	80% < 1,000	80% < 200	80% < 5,000	80% < 1.000		80% < 20,000	80% < 40.000	Ministry of Health of Peru (1983)
Mexico	70[e]	80% < 1.000[f] 100% < 10,000 k			10,000[e] 80% < 10.000 100 % < 20,000			
Jamaica			20					Personal communication
Yugoslavia		2.000						INCyTH, Argentina (1984)
Israel			80% < 1,000 g					WHO (1977)
U.S.S.R.					E. coli < 100			WHO (1977)
Poland					E coli < 100			ECC (1976)
ECC[b]			500[c]	100[c]	Fecal Strepto-cocci			ECC (1976)
Europe			10,000[d]	2.000[d]	100[c] Salmonela /1[d] Enterovi-rus /1[d]			ECC (1976)
Cuba				< 200				Personal communication
Colombia			1,000	200				Ministry of Health (1984)
Brazil			80% < 5,000[m]	80% 1.000[m]				Ministry of the Interior
Barbados				200				Personal communication
Japan	70		1,000			1,100		Environmental Protection Agency, Japan (1981)
France			< 2,000	< 500	Fecal Streptococci < 100			WHO (1977)

Footnotes for Table 5.

a/ Logarithmic average of at least five samples for a 30-day period.

b/ Minimum sampling frequency every two weeks.

c/ Guideline.

d/ Mandatory.

e/ Monthly average.

f/ At least five samples per month.

g/ Minimum 10 samples per month.

h/ At least five samples taken from the waters sequentially at a given time.

i/ 30-day period.

j/ Within a confined zone between the shoreline and a distance of 1000 ft. from the shoreline or at the 30 ft. depth curve, whichever is farthest from the shoreline.

k/ No simple sample taken during a verification period of 48 hours should exceed 10,000/100 ml.

l/ 60-day period.

m/ "Satisfactory" water, samples obtained during each of the previous five weeks.

COSTA RICA

42. Although Costa Rica does not have an officially established criteria, it does have studies and interesting experiences which support the need to review the parameters and values established or adopted by other countries. They make specific reference to the fact that they have been carrying out a systematic research on the bacteriological criteria, and that this project has allowed them to note the differences from the assumed values of the relationship between faecal coliforms and total coliforms in coastal waters.

43. The results of a study of one thousand water analyses aimed at determining the relation between total coliforms (T.C.) and faecal coliforms (F.C.) show that 63% of the total coliforms are faecal and that in 20% of the MPN tests, 66% of the bacteria identified (complete test), were E. coli. One may conclude that the total coliforms are found in amounts twice that of fecal coliforms - a relationship quite different from that generally accepted, especially in the technical literature of the United States, in which faecal coliforms are on the order of 20% of the total coliforms present in the coastal waters.

44. Likewise, the study of the correlation of the MPN of fecal coliforms/100 ml. with the isolation of Salmonella bacteria, indicates that in 70% of cases in which the above bacteria is present coincided with values greater than 240 faecal coliforms at the same sampling time. (These results coincide with others from estuary waters). Locations at which these values exceeding 240 c.f./100 ml. were found to be highly polluted due to the direct discharge of sewage into the sea, together with high indices of intestinal parasitism in the population. No linear relationship was found between coliform density and water turbidity and color.

45. Finally, the Costa Rican document suggests that "the concept of acceptability [must] respond to social, cultural, economic and political factors, as well as to that of health". As a result of the studies mentioned above the, National Bacteriological Criteria for Recreational use of sea water (swimming) have been established:

Class A: Water safe for swimming

Total Colif./100 ml. <200 (xg) or 80% < 460 (MPN)
Fecal Colif./100 ml. <100 (xg) or 80% < 240 (MPN)

Class B: Water suitable for swimming but subject to periodic testing and inspection

Total Colif./100 ml. 200 - 400 (xg) or 80% < 1000 (MPN)
Fecal Colif./100 ml. 100 - 240 (xg) or 80% < 460 (MPN)

Class C: Water unsuitable for swimming

Total Colif./100 ml. > 500 (xg) or 21% > 1000 (MPN)
Fecal Colif./100 ml. > 240 (xg) or 21% > 460 (MPN)

46. In order to establish Class C, the detection of the pathogenic bacteria Salmonella sp. in 70% of the samples with MPN above 240 c.f./100 ml. was the determining factor. This recommendation was made, taking into account that the bacteria of the coliform group (E. coli) do not survive in seawater and approximately 90% perish within 24 hours; therefore, they are only good indicators of recent pollution.

CUBA

47. Table 4 presents a summary of the coastal water quality parameters and criteria currently employed in Cuba. Although there are no formally established effluent standards in Cuba, they have been established conditionally by taking into account factors such as use of the area, the existing level of pollution, and other environmental considerations. This sort of evaluation is carried out within the process of investment evaluation.

48. Some fundamental parameters are used within the ranges dictated by the consideration whether the marine areas are closed or open. There is a difference in environmental quality of five to ten orders of magnitude between these two poles in parameters such as oxygen demand and fecal coliforms, while for heavy metals the difference is even more marked, in the order of 4 to 20 times.

49. For areas of interest to fishing and swimming (recreation), there are stricter standards. In the case of recreational areas, values are set for faecal coliforms/100 ml. at up to 200 organisms, and 1000/100 ml. for total coliforms, grease levels of no more than 0.5 mg/l, oxygen saturation greater than 70%, and pH of 6.1 to 8.9.

50. For the particular case of fishing waters, Cuba has introduced biological indicators different from the usual fecal contamination indicators, such as the diversity index of Brillouin, together with other physico-chemical indicators and total coliforms. Additionally, Cuba has proposed a procedure to classify the quality of fishing waters as good, dubious and acceptable.

51. Cuba is signatory to the 1983 Cartagena Convention for Protection and Development of the Marine Environment in the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills Within the Region.

DOMINICA

52. Dominica recognizes the importance and need of coastal environmental quality standards, and although the country has still not developed them, the will and desire to do so is there. The Government of Dominica believes that events such as this can help in the local and national development of such criteria by furnishing information and allowing the exchange of experiences.

FRANCE (GUADELOUPE AND MARTINIQUE)

53. The French Overseas Departments of Guadeloupe and Martinique have adopted the Water Quality Criteria of the European Economic Community (EEC) of 8 December 1976.

54. Regular monitoring programmes for recreational waters have been established for both islands. The results of the yearly surveys are mapped and are available to the general public. In the particular case of sewage effluent, control and analysis are carried out by the competent sanitary authorities. The standards and criteria are described in the Government's regulations of 1982. The two islands have natural reserves for fishes, mangroves and wildlife.

55. France is signatory, with reservations, to the 1983 Cartagena Convention for Protection and Development of the Marine Environment of the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

HAITI

56. The Republic of Haiti is now in the process of reviewing current practices in the field of environmental quality criteria, and at the moment does not have available standards.

JAMAICA

57. The quality of coastal waters in Jamaica is monitored by the National Resources and Conservation Department (NRCD), while the quality of potable water is the responsibility of the National Water Commission. On the other hand, the Ministry of Health, through its Environmental Control Division, deals with the monitoring of sewage discharges. With regard to industrial effluent discharges, the NRCD is also responsible for its monitoring.

58. Jamaica does not have formally established standards for effluent discharge; however, there are operational standards that are applied to effluents and water bodies. These operational standards are based on U.S. EPA and WHO standards. A classification for water usage has been adopted, consisting of seven (7) classes as follows:

- Potable water after disinfection
- Water adequate for swimming
- Potable water after full treatment
- Water for fish development and agricultural uses
- Marine water
- Ground water
- Coastal water surrounding the Island

59. Regarding the above-mentioned operational standards, some are numeric while others are descriptive. The establishment of a water quality criteria suitable for Jamaica will require further study and research.

60. Anderson and Anderson (1989) pointed out that environmental legislation in Jamaica is fragmented and administered by several Government agencies. This has resulted in duplication of efforts among the agencies and competition for the small amount of funds assigned to carry out these activities.

61. Jamaica is signatory to the 1983 Cartagena Convention for the Protection and Development of Marine Environment in the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills Within the Region.

MEXICO

62. The Secretary of Urban Development and Ecology established by Accord 001/89 the ecological criteria for water quality, consisting of the establishment of minimum quality levels required for various uses of water (potable water, primary contact recreation, agricultural uses such as irrigation, livestock uses, aquaculture, and conservation of aquatic life).

63. For the establishment of values for each parameter, a wide variety of quality and use of the country's bodies of water was taken into account, so that the purposes of provision for potable water and for recreation, factors such as carcinogenicity, toxicity and organoleptic characteristics were considered.

64. The values given refer to the allowable levels in the body of water, if the water is to be utilized for human consumption. Also taken into account were such factors as bioaccumulation and the normal development of aquatic species. One hundred and twenty-eight (128) parameters were selected, including the values required for the protection of aquatic life in both fresh and sea waters in coastal areas.

65. Additionally, quantitative criteria were set for seven types of aquaculture activities (four fish, two crustacea, and one mollusk) for 29 parameters.

66. In establishing each value, the results of acute toxicity tests were used, multiplied by a factor of 0.01; likewise, it was estimated that the average concentration of several substances over 96 hours should not exceed values found by means of specific equations more than once every three years.

67. Mexico has a sanitary code (Ley 21) that establishes the regulations for chemical and bacteriological standards for both potable and waste waters. Mexico is signatory to the 1983 Cartagena Convention for Protection and Development of the Marine Environment of the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills within the Region. Mexico is also signatory to the MARPOL 73/78 Annex on Regulations for Prevention of Pollution by oil and protocols dealing with reports on incidents involving pollution by oil and arbitration procedures. Mexico also has bilateral agreements with the United States with regard to co-operation in case of pollution by oil spills and other hazardous substances.

PANAMA

68. In Panama, several national competent institutions have reached a consensus on the proposed Quality Criteria for Recreational Waters, and these criteria are in the process of being adopted as national laws.

69. The Ministry of Health, the Institute of Water Resources and Electrification (IRHE), the National Aqueducts and Sewers Institute (IDAAN), the National Institute for Renewable Natural Resources (INRENARE) and the National Council for the Environment have all taken part in drafting the above-mentioned laws.

70. The technical standards of Brazil and Guatemala have been consulted in the preparation of the national laws. In the documentation provided for this compilation, only the definitions of the various substances to be regulated were given. For sewage treatment plants, the standards are the removal of 80% of BOD and total suspended solids.

71. Panama is signatory to the 1983 Cartagena Convention for Protection and Development of the Marine Environment in the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

ST. KITTS AND NEVIS

72. The Ministry of Health is working in conjunction with St. Lucia Caribbean Environmental Health Institute (CEHI), in evaluating the bacteriological conditions of coastal waters in some locations. The Pan American Health Organization (PAHO) standards are used.

TRINIDAD AND TOBAGO

73. Trinidad and Tobago is in the process of carrying out acute toxicity tests for petroleum hydrocarbons, expressed as dissolved fractions of local crude. The Ministry of Energy has established provisional effluent-discharge limits for fats and oils for continuous values (monthly averages) or 75 ppm as a daily maximum. In open-sea locations, approximately 20 km. from the shoreline, the limits are 100 ppm as a monthly average and 150 ppm as a daily maximum. There is an ongoing discussion between the oil companies and the authorities proposing these levels. In tentatively establishing these values, sampling was performed over a period of time and international standards were reviewed.

74. The Institute of Marine Affairs is interested primarily in the protection of marine life, and will therefore base its environmental standards and norms on field observation and the results of toxicity tests.

75. Although there are no local standards for recreational uses, a combination of U.S. EPA, EEC, and WHO standards has been employed for waste water pollution. There are plans to use the new EPA standards (1986) for enterococci as indicators.

76. The evaluation of coastal water quality is achieved by a comparison with values in areas where no pollution exists and which possess similar ecological conditions.

77. With respect to the operation of waste water treatment plants and the quality of their effluents, standards are being jointly developed by the Institute of Marine Affairs and the Office of Standards; however, they have proposed different standard values for BOD and total suspended solids, if the waste discharges are done at sea and based on the sensitivity of the sites to sewage pollution.

78. The Water and Sewer Authority employs WHO standards for potable water supply. According to Myers and James (1989), there are some weaknesses regarding the organized co-ordination of the agencies involved in environmental management, legislation and strategies, to deal with the pollution problems.

79. Trinidad and Tobago is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

UNITED STATES

80. There is a large amount of literature on Environmental Quality Criteria in the United States, largely a product of the work of the Environmental Protection Agency (EPA). Among the literature utilized for this compilation, the following works were consulted: US EPA (1987) on regulation concerning chemical pollutants (organic and inorganic), US EPA (1988 a) on State quality standard summaries, US EPA (1988 b) on national industrial effluents guidelines, US EPA (1990 a), a compilation of federal criteria and US EPA (1990 b) on major environmental laws on water pollution. The EPA generates water quality criteria at a federal level, which are considered as guides to evaluate the toxic effects of pollutants on the human health and marine biota. These federal criteria are used or considered by the various States in the establishment of their own water quality standards or norms, and the States establish allowable limits of a legal and obligatory nature. State Standards for Water Quality designate the uses and allowable pollution limits for various elements, in order to protect those uses.

81. Federal Water Quality Criteria are divided into six (6) categories: two are concerned with human exposure (ingestion of contaminated water or fish) and four with registering chronic and acute toxicity for continental and seawater aquatic life. Table 4 presents current information on the various numerical values allowed for each substance, taking into account the fact that continental waters are defined as those whose level of salinity is equal to or less than five (5) parts per thousand, while sea water is defined as that greater than this value.

82. Besides the quantitative criteria, there is also in use a "narrative" set of criteria (e.g., "contaminants must not be present in dangerous amounts...") and/or an operational set (e.g., contaminant concentrations must not exceed 10% of the 96-hour LC50) if it is not possible to derive a numerical value. The methodology employed in the United States, in developing these numerical criteria is set forth in the document titled, "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses." In general terms, this procedure consists of obtaining data on one-hour LC50 acute toxicity and 96-hour LC50 chronic toxicity for various animal species distributed throughout the trophic chain, plus toxicity for plants and bioaccumulation, in order to derive maximum and continuous concentration criteria (see figure 1).

FIGURE 1.

Derivation National Numerical Water-Quality Criteria For the Protection of Aquatic Animals and Their Uses

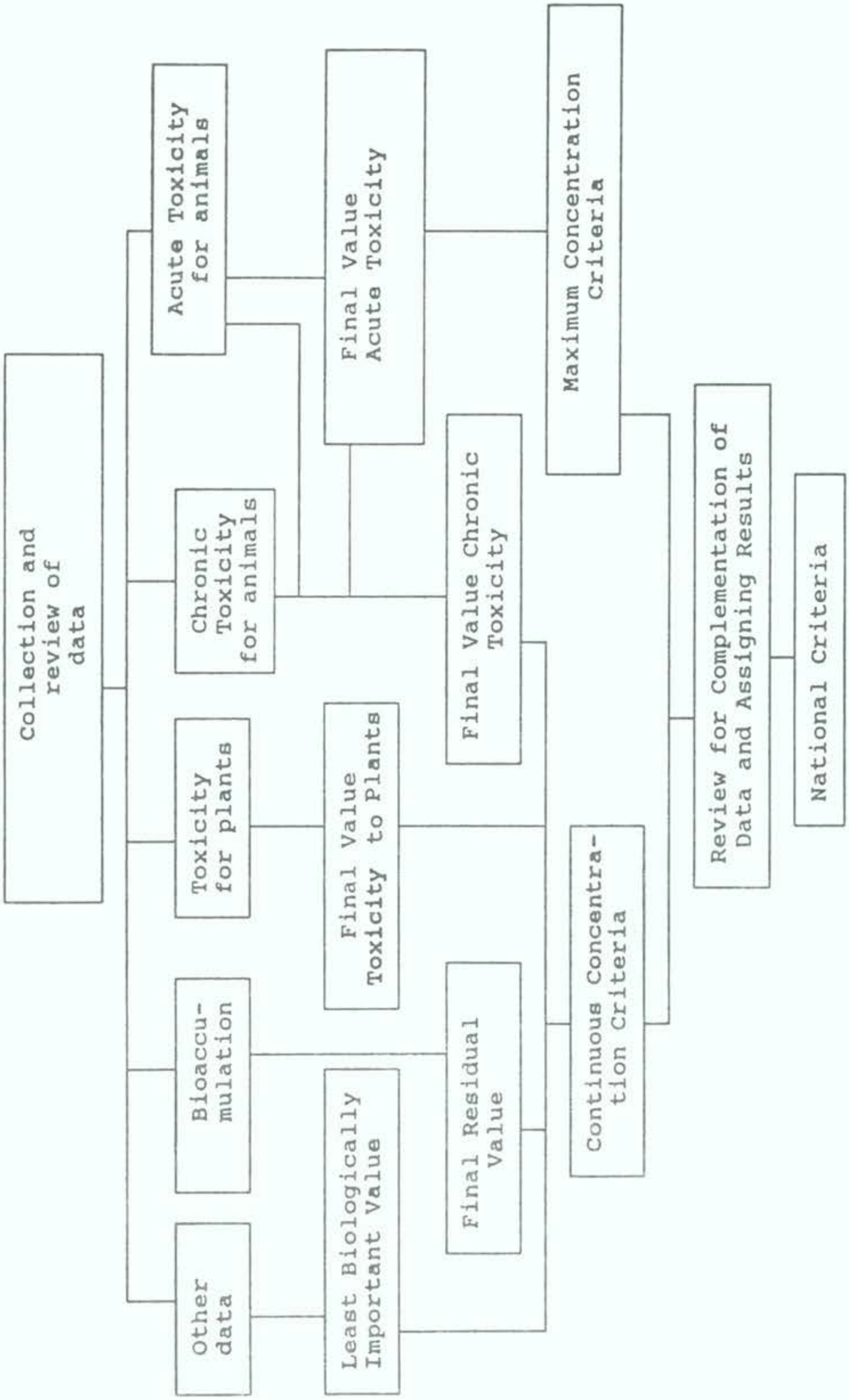
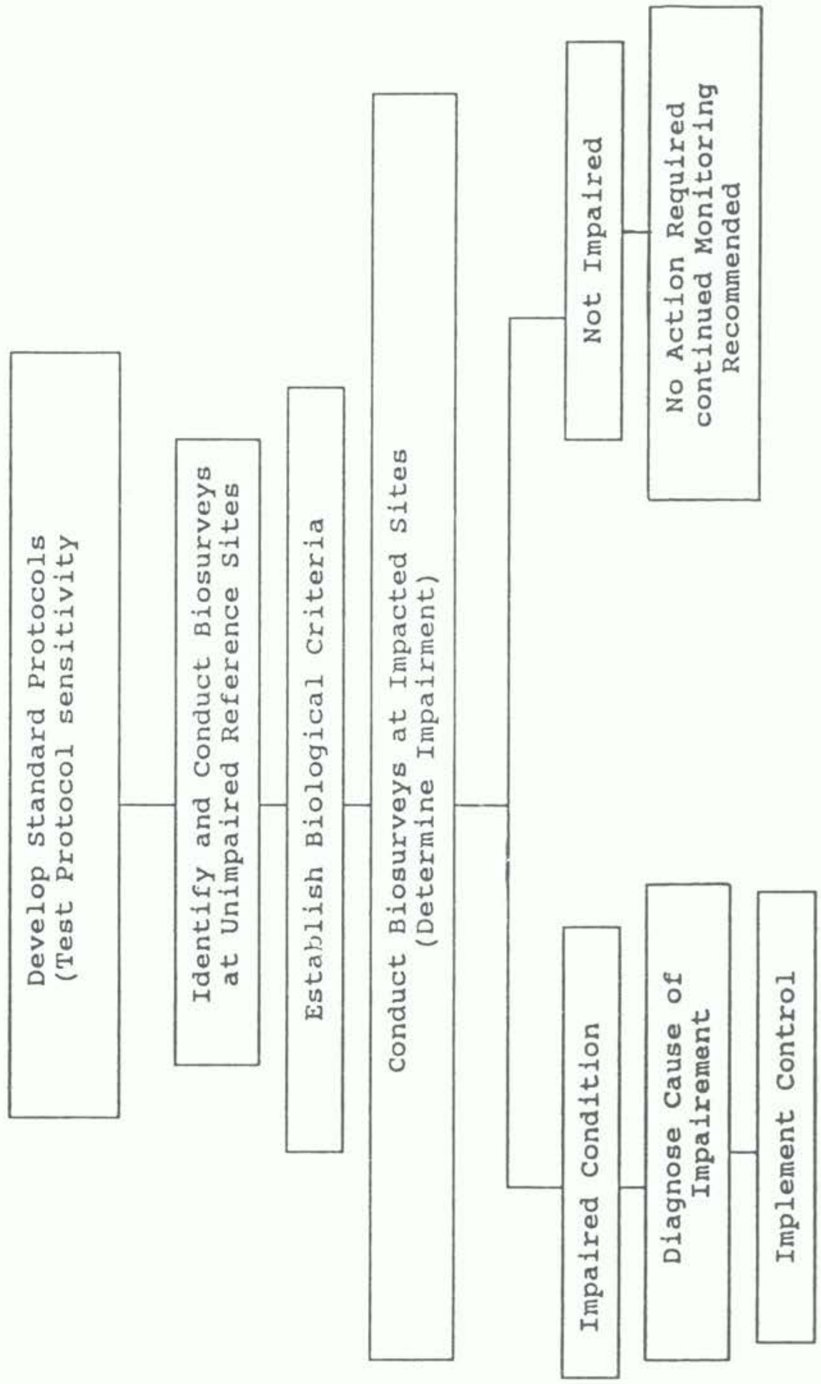


FIGURE 2.

Process for the Development and Implementation of



After Biological Criteria National Programme Guidance
U.S. EPA (1990)

83. Within the National Water Programme (U.S. EPA, 1990) methodologies have been developed to establish biological criteria of water quality. These criteria are very useful because they determine the conditions under which the resource to be protected will deteriorate. These criteria also detect problems that other methodologies underestimated or will not detect. The above-mentioned methodologies are excellent tools to measure the results of programmes to preserve the biotic quality of different ecosystems. Moreover, the above criteria will require direct observations on the structure and function of the aquatic communities; however, they do not totally replace the classical chemical and toxicological methodologies. The biological water quality criteria can be narrative (e.g., the natural variety of organisms should be present and all the groups should be well CEP Technical Report No. 14 represented), or numeric (a description of the integrity of the aquatic communities, e.g. niches of species, abundance of taxa and distribution of types of organisms). In order to properly develop the biological criteria, it will be necessary to: (1) identify water bodies that have not been altered by pollution to establish standards of reference, and (2), characterize the aquatic communities present on those water bodies. Figure 2 shows the process for the development and implementation of the biological criteria.

84. When an aquatic community has been affected by pollution and it is not possible to determine the cause, the cost involved in the diagnostic process will determine how many iterative loops will be completed in the process. Figure 3 illustrates the diagnostic process.

85. To determine the toxicity of complex effluents, the U.S. EPA (1989) has developed a programme with the following main objectives: (1) through bioassays the rapid estimation of the effluent's toxicity to proceed with regulating actions, and (2), to contribute to the knowledge of the ecosystems and their trends to improve their long-term protection. The species to be used in the bioassays (fishes, sea urchins, macroalgae, etc.) are selected according to the following considerations:

- Easy to culture under laboratory conditions.
- Disponibility year round of larvae and gametes in their natural environments.
- Larvae and gametes that require very little water to be maintained.
- That the tests are economical and easy to reproduce.

The general guidelines for the development of chronic toxicity tests are presented in Table 6.

FIGURE 3: **Diagnostic Process**

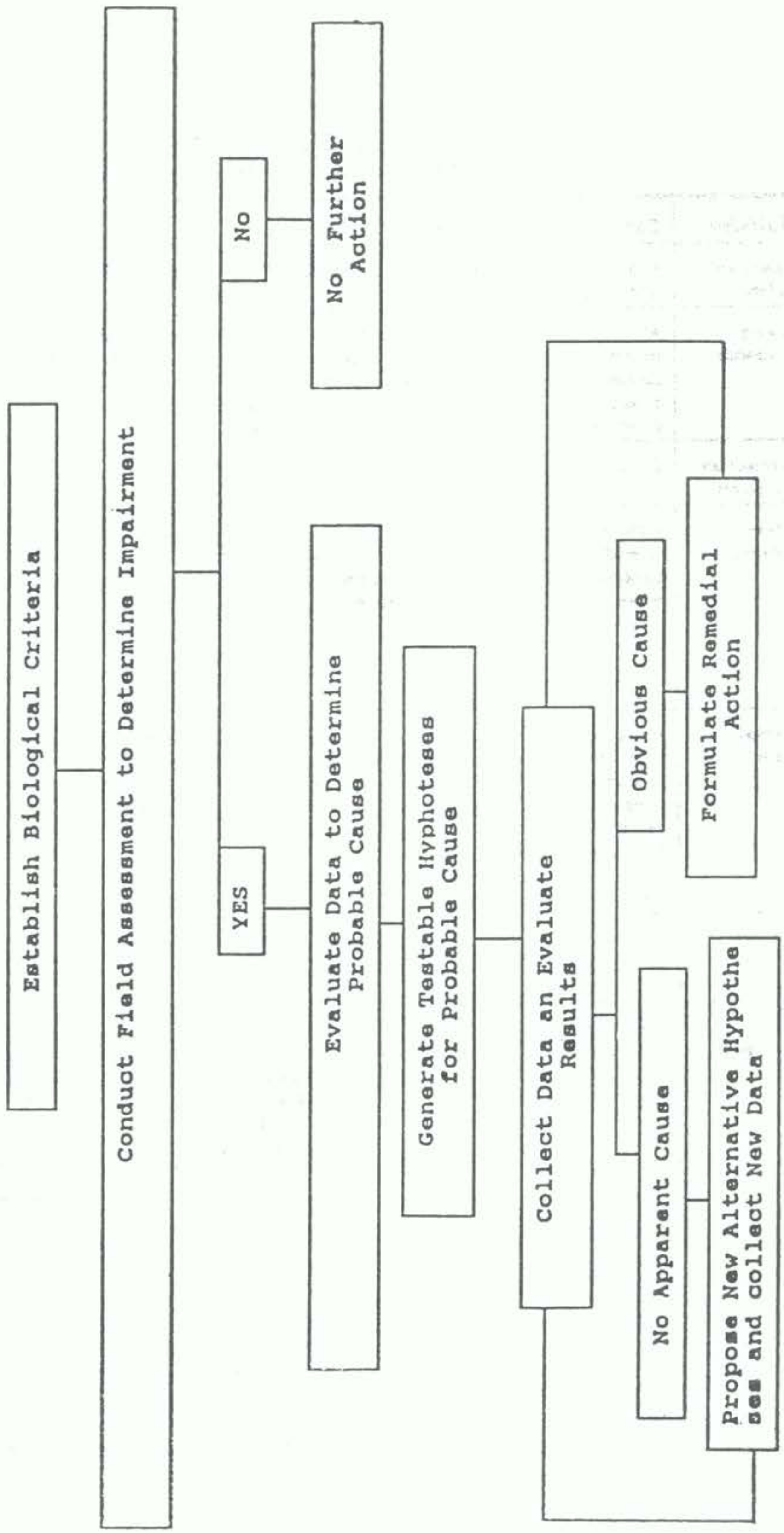


Table 6: *General Guidelines for Short-term Marine Complex Effluent Toxicity Methods*

Guideline	*Description of Guidelines*
Health and Safety	Appropriate measures should be taken to protect against possible health hazards derived from effluents or receiving waters.
Quality assurance	All tests should be performed by aquatic toxicologist or under their supervision. Tests require high-quality test conditions to ensure confidence in test results. Quality considerations include: animal health, sample collection and handling methods, instrument condition and calibration, adequate controls and replication, accurate record keeping, use of reference toxicants and test acceptability criteria.
Facilities and equipment	Tests can be conducted in an appropriately equipped stationary or mobile laboratory.
Effluent samples	Water samples should be collected just prior to the start of tests. Water samples are generally collected as 24-hour composite samples, which are appropriate when the components of an effluent remain relatively constant in volume and abundance. (Note however, that this sampling method may not adequately represent short-term peaks in toxicity. This type of toxicity must be addressed using acute tests on grab samples). Samples of whole effluents are collected at the discharge site while receiving waters are collected at a series of predetermined sampling stations, representative of varying degrees of impact.
Dilution water	A range of test solutions is created with varying effluent concentrations to determine the concentration of effluent that is toxic to the organism. Five different effluent concentrations and a control containing no effluent are selected for each test. Careful steps are taken to ensure that salinities in all samples are identical and remain constant throughout the experiment. Salinity is adjusted with the aid of either artificial seawater (for some but not all species), or with hypersaline brine, made from evaporating high quality filtered seawater. Seawater of desired salinity is created by mixing a proportion of brine with deionized water.
Endpoints for chronic toxicity tests	Endpoints in these tests include survival, growth, fecundity and reproduction.
Statistical analysis of test results	The statistical analysis of these tests should be conducted by or with the aid of a qualified statistician, through a series of statistical tests, two different estimates of the toxicity of an effluent are made: the NOEC (No Observed Effect Concentration), an estimate of the highest concentration that will not have a significant effect on the organism, and the EC (Effective Concentration), an estimate of the proportion of organisms that will show effects at any given concentration.

Source: U.S. EPA (1989), *Biomonitoring for control of toxicity in effluent discharges to the Marine Environment*.

Notes:

(1) These General Guidelines refer to the conduct of all tests mentioned in this section.

(2) Composite sampling is generally conducted automatically with a collection apparatus placed adjacent to a discharge. A 5-liter water sample is often collected over a 24 hour period by collecting small volumes of water at regular intervals.

86. The methodology being used is aimed at estimating the chronic toxicity of the effluents or the receiving waters on the sexual reproduction of macroalgae. These marine algae are considered less sensitive to toxic compounds than marine animals because the results were obtained based on growth rates; however, the tests based on reproduction seem to be more sensitive for macroalgae than for marine animals.

87. Another method is based on obtaining male and female gametes from sea urchins by electric stimulation. The sperm is exposed to the pollutant and then added to the ovules to determine the percentage of fertilization.

88. The tests with fish larvae consist in exposing the fertilized embryos to different effluent concentrations for a period of nine days and determining the survival of the larvae without deformities.

89. Of the methods developed for biomonitoring in situ, the most successful one is described in Table 7. The monitoring at the cellular level can simplify the study because it allows the estimation of the effects of the effluents at the above-mentioned level and the prediction of its effects over other species. However, the relationship between cells, tissues, individuals and populations must be clearly understood prior to extrapolation. Other methods are based on biomarkers which in essence are biomolecular techniques that allow types of chemical compounds to relate with biological effects in a direct manner. Two examples of biomarkers are the increment and exchange of chromatid pairs and the increment on the synthesis of metalothionine compounds in marine organisms.

90. The methods used to determine the acute toxicity of effluents in macroinvertabrates and fish are described in the U.S. EPA manuals (US EPA 1985 and 1988). They include preliminary tests, selection of tests and multiconcentration effluent tests under static and flow through conditions. The above-mentioned manuals include the following: guidelines for safe procedures in the laboratory, assurance of quality results, facilities and equipment, collection and handling of samples, water for dilution, selection and handling of species, interpretation of results and use of the obtained information; computer programmes to calculate LD 50 with a 95% level of confidence, statistic comparison of the LD 50, Dunnetts procedure, probit analysis, culture of organisms and design of mobile laboratories.

91. The United States of America is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region, and to the

Table 7: ***Methods in Use and Development of in Situ Monitoring***

Method	*Level of Complexity*	*Level of Biological Organization Tested*	*Description of Method*
Methods Discarded			
Adenylate Energy Exchange (AEC)	High	Cellular	The amount of energy available to an organism from the pool of adenine nucleotides (ATP, ADP and AMP) can sometimes be affected by stress. AEC is not significantly affected by contaminants concerned and has been discarded.
Blood Chemistry	Medium	Cellular	Changes in the relative abundance of several normal blood components might have indicated pollution effects.
Methods Requiring Refinement			
Biomarkers including metallothionein induction, sister chromatid exchange, immunosuppression	High	Cellular	There exist several potential biomarkers or sublethal biochemical indices which might be used as early biological sentinels of pollution effects.
Histopathology	Low	Organ	Visual examination of sensitive tissues such as gills, liver and reproductive organs may indicate structural tissue damage in response to contaminant exposure.
Tissue microbiological contamination	Medium	Organ, system	Various bacteria might be used as tags for contaminated sediments.
Demographic analysis	High	Population	Population dynamics can be inferred from the computer compilation of individual responses to contamination along a gradient.
Quantitative benthic sampling	High	Population	Community structure and contaminant effects can be determined by estimating benthic species diversity and relative abundance.
Methods that Can Be Used Immediately			
Growth, survival and fecundity tests	Low	Individual	Toxicity in the sexual reproduction of macroalgae, viability of sea urchin's gametes, development of fish larvae.
Scope for growth (SFG)	Medium	Individual	The energy left for growth and reproduction after routine metabolic costs. SFG decreases with increased contaminant exposure.
Gill respirometry	Medium	Organ	Health of animals determined by the respiration rate of excised gill tissues. (Produces results which are redundant to SFG so the test is not used).

Reference: U.S EPA (1989), Biomonitoring for control fo toxicity in effluent discharge to the marine environment.

Protocol on Co-operation for Combatting Oil Spills within the Region. The USA also has bilateral agreements with Mexico for mutual assistance in the case of pollution of the marine environment in the Gulf of Mexico.

THE BRITISH VIRGIN ISLANDS

92. A permanent programme on coastal water quality, consisting of a monthly sampling for fecal and total coliforms in various locations in bays and the open sea, is being established. For this, values adopted by the US EPA are being used to distinguish between polluted and unpolluted waters. A follow-up on water turbidity and clarity is carried out, especially in relation to the many dredging and reclamation projects underway, taking as a minimum quality standard 1.0 meter (Secchi Disc) of vision during dredging operations. (Dredging plans and geological samples are also required).

93. Additionally, there are plans to begin sampling for nitrate and phosphates in 1991, and acceptable values are being identified in order to establish the quality standard.

94. The United Kingdom is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

VENEZUELA

95. The Ministry of the Environment and the National Renewable Resources (MARNR) of Venezuela has prepared the regulations for the classification of waters and the legislation for pollution control of littoral waters and coastal lagoons, e.g. Lake Maracaibo, Lake Valencia and rivers. In the particular case of Lake Maracaibo, the legislation on parameters for industrial waste discharges directly into the lake, via water bodies or through the sewage system, is specific.

96. The above-mentioned legislation was prepared in 1985, and it contemplates the characterization and monitoring of effluents by designated laboratories, including terms for the treatment of effluents and penalties. In table 4, the norms for domestic and industrial discharges in Venezuela are presented. Additional legislation related to the classification of the waters of Lake Valencia is contained in resolution No. 4. Resolution No. 31 provides norms for effluents, the law on surveillance to avoid pollution by oil; and decree No. 1164, on the preparation and implementation of contingency plans for massive oil spills.

97. Venezuela is signatory to international conventions for the prevention of pollution from ships and to the MARPOL 73/78 Annex on Regulations for Prevention of Pollution by Oil. Venezuela is also signatory to the 1983 Cartagena Convention for Protection and Development of the Marine Environment of the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

OTHER COUNTRIES

98. The following information corresponds to states and territories for which only fragmented information was available at the time of the preparation of this document.

ANTIGUA AND BARBUDA

99. Antigua and Barbuda have adopted US EPA standards and criteria. The country is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

GRENADA

100. Grenada is signatory to the 1983 Cartagena convention on the Protection and Development of the Marine Environment in the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

GUATEMALA

101. Articles 96 and 97 of the Guatemala Constitution establish that the state, the municipalities and the inhabitants of the country are required to promote the social and technological development necessary to prevent pollution of the environment and to maintain the ecological equilibrium of the natural systems. Moreover, law No. 68 of 1986 on the protection of the environment, created the National Commission for the Environment, and law No. 72 of 1982 established the norms for civil responsibility for the pollution of coastal waters by oil.

102. Guatemala is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

GUYANA

103. According to Chin and Liu (1989), Guyana has not yet formulated policies for environmental management and sustainable development, although the Constitution of the country makes reference to two articles on environmental protection and the rational use of natural resources.

HONDURAS

104. Honduras has adopted US EPA and Mexico standards and criteria. The country is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

NICARAGUA

105. Sanitary regulations regarding the quality of potable water, waste disposal, toxic wastes and epidemiological control are recorded in the Sanitary Disposition No. 394. Nicaragua has created IRENA "Instituto Nicaragüense de Recursos Naturales y del Ambiente" to deal with matters related to environmental protection. Nicaragua is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

DOMINICAN REPUBLIC

106. The Dominican Republic has a Public Health Code (Law No. 4471), which contains guidelines for the mitigation of environmental pollution problems. However, according to Garcia et. al. (1989) no Government agency has been designated to plan and implement environmental policies; therefore, several agencies such as the Secretary of Natural Resources, the Environmental National Commission, the National Parks Direction and the Technical Commission on Forestry are independently managing the environmental problems.

ST. LUCIA

107. St. Lucia is the site of the Caribbean Environmental Health Institute (CEHI), which carries out monitoring programmes on the quality of coastal waters within the OECS region. St. Lucia is signatory to the 1983 Cartagena Convention for the Protection and Development of the Marine Environment in Wider Caribbean Region, and to the Protocol on Co-operation for Combatting Oil Spills within the Region.

VI. A BRIEF DISCUSSION ON THE ENVIRONMENTAL QUALITY STANDARDS AND CRITERIA

108. Information received from 18 of the 35 CEPPOL Focal Points indicates differences in both conceptual and operational outlook of environmental quality criteria and parameters. In Aruba, World Health Organization (WHO) and Dutch standards are utilized; Barbados emphasizes chemical parameters, for which it has established a water classification system. Belize does not have numerical criteria, but does use a normative system related to pollution. In Colombia, besides the conventional contaminants, 141 substances of sanitary interest have been listed, and water-quality criteria and effluent emission standards have been established for various uses. Costa Rica has national standards for bacteriological quality in its coastal waters, following an epidemiological study of those waters. Cuba has established ranges for closed zones and open waters for conventional contaminants, including some heavy metals;, and, probably even more important, has established a system of consultants for the development of new industries, so that from the beginning they will take into account the means available to control pollution. This also includes biological considerations when the water body is used to support fisheries or to protect the fauna. In Dominica, quality standards do not exist. Haiti is developing these standards, but at the moment they are not available. The United States Environmental Protection Agency (EPA), possesses extensive literature and has developed criteria for several non-conventional contaminants. The French overseas Departments of Guadeloupe and Martinique follow the standards of the (EEC) and the Cayman Islands perform periodic data collection on the physical-chemical parameters under the guidelines provided by WHO. The British Virgin Islands utilize the US EPA criteria. Jamaica, uses both the US EPA and WHO standards. Mexico has drawn up quality criteria for coastal waters for 88 parameters, divided into seven categories, and has made advances in the field

without indicating a numerical value, and makes reference to Brazil, Guatemala and Peru in the establishment of its criteria. St. Kitts and Nevis use the criteria of the Pan American Health Organization (PAHO). Trinidad and Tobago uses a combination of standards from the Environmental Protection Agency (EPA), The European Economic Community (EEC), and the World Health Organization (WHO). Venezuela has prepared its own legislation.

109. It is clear that a good number of the countries that have made somewhat more progress than others in the area, at least insofar as the definition of quantitative standards for environmental quality is concerned, have followed in one way or another, the suggestions of the EPA and other European entities.

110. Though this procedure is not incorrect per se, there has been no attempt to support the decision to adopt (for example) EPA and WHO standards. One would assume that given the lack of information and resources, it would be better to establish some value, even one "borrowed" from other circumstances and conditions, while the country is in the process of developing its own standards. The simple adoption of one particular group of standards is inappropriate without a careful review of the local and national circumstances and the social, economic and cultural implications of the imposition of these standards.

111. There is also a marked predominance of physical and chemical parameters, indicators and standards. This may be as an expression of an approximation in which ecological phenomena may be better explained by means of balances or estimates of equilibrium between its abiotic components, or as a demonstration of our lack of knowledge of the biotic component.

112. This feature of the standards merits thought, since it does not contemplate the diversity of living species, which in the tropics may easily mean orders of magnitude from one to 100 times that of areas outside the region. Thus, an important contribution of the measurement of coastal water quality in the Wider Caribbean Region may be a deeper study of the ecosystems and the use of in situ bio-indicators.

113. It is obvious that the physio-chemical parameters or bio-indicators are in large part easier to measure most of the time, and that some of them represent a shorter length of time; however, the use of a balanced combination, with such methodologies as bio-assays, toxicity tests and appropriate use of bio-indicators would even allow for follow-up environmental quality systems to be established in which the community would take part.

114. There has been some experience in continental waters (Universidad del Valle, Cali, Colombia) which indicates the desirability of using bentonic and neuston bio-indicators, which may be learned by members of the community and do not require costly instruments or reagents; thus, public participation is encouraged, as is interaction between members of the community and the technicians.

115. At any rate, it is desirable to keep in mind the limitations of the various indicators. Physio-chemical parameters have temporal limitations, since they register readings for a determined period of time (the duration of the sampling), while biological indicators might show situations or tendencies of longer duration. Nevertheless, generational adaptation, modifications of ecosystems exposed to differing sources of stress, etc., show us that one must exercise prudence in the conclusions drawn from these procedures.

116. Another aspect not dealt with or which appears insufficiently in the information received (with the partial exception of the United States) is the issue of statistical representativeness. There is a marked tendency towards mechanical follow-up on the instructions and guidelines of entities such as the APHA and the AWWA with regard to the procedures for sampling and analysis, although the statistical representation of the local spatial and temporal conditions of these procedures is not specified.

117. Additionally, strict and apparently very precise numerical values are adopted for some parameters. Nevertheless, support for these values is not often or easily found in the technical literature, nor to an even greater degree their adaptability to tropical conditions.

118. The World Health Organization (WHO) states that the recommended upper limits for indicator organisms should be expressed in global terms of orders of magnitude rather than as a specific numerical limit. Salas (1985) indicated that the microbiological standards may be expressed as an average allowable concentration, and with a maximum value not to exceed a given percentage over time (90% being usual). Recent studies seem to indicate different relationships between faecal and total coliforms than those conventionally accepted. On the other hand, Enterococci seems to relate better than coliforms with regard to illnesses contracted by swimmers through primary contact or ingestion. This observation is particularly important for marine waters, taking into consideration that E coli bacteria has a 90% mortality rate of 18 hours in the marine environment while in fresh water the rate is 110 hours. In comparison, Enterococci has a 90% mortality of 47 hours in the marine environment and 71 hours in fresh water (quoted

by Dufour, 1984). Dutka (1976) pointed out the bacteria Pseudomonas aeruginosa as an indication of water quality, particularly taking into account that the above-mentioned bacteria is related to respiratory infections in humans. Dutka indicated that there is a direct relationship between human activity and the presence of Pseudomonas aeruginosa in recreational waters. This microorganism can provide an estimation of recent contamination of the above-mentioned waters and the potential to contract ear, eye, nose and throat infections. These infections represent more than 60% of the infections related to aquatic sports.

119. The derivation of numerical (quantitative) criteria for the protection of environmental quality, and specifically for aquatic organisms and their use, is doubtlessly a complex process requiring information on aquatic toxicology from many areas. Stephen et. al., (1985) have examined the subject and suggest that after all the available information on toxicity and bioaccumulation in aquatic organisms has been collected and analyzed for acceptability and classified, information on critical toxicity can be used to estimate the minimal levels of contaminants that produce unacceptable effects on aquatic organisms and for their possible uses.

120. Information on chronic toxicity can likewise be used to estimate the highest concentration for four-day (96-hour) periods which should not cause unacceptable toxicity in an exposure over a long period of time. If this concentration is considered appropriate, it may also be related to water-quality characteristics.

121. Stephan et. al. (1985) likewise suggest that information on toxicity in plants be examined in order to determine whether plants might suffer unacceptable effects when exposed to concentrations considered acceptable for animals. Information on bioaccumulation in aquatic organisms serves to set restrictions on the consumption of certain species (e.g., those restrictions imposed by the United States Food and Drug Administration) or demonstrate whether these residues may negatively affect wildlife species which consume aquatic life. Additional available information serves to allow one to examine possible adverse effects which may be biologically important.

122. The simple adaptation of a particular group of standards is inappropriate without careful review of local circumstances and of local/national social and economic effects. All these facts indicate the need to strengthen the coordinated labour of all concerned in the search for efficient, effective environmental quality criteria and parameters for coastal waters, resulting in increased well-being and sustainable development in the Wider Caribbean Region.

123. Environmental quality criteria may be qualitative or quantitative and a satisfactory combination of the two, depending on the existing level of specific knowledge, results in a more efficient formula for environmental action. Quantitative criteria are expressed by physical, chemical and biological parameters or indicators, and have permitted the definition of 126 "priority contaminants" (EPA) to date. Biological parameters reflect conditions that are of temporal or longer duration and statistical representativeness. In the field of bioassays and bioindicators, considerable progress has been made, though ecosystem complexity and limited knowledge of the range of variables has limited this progress somewhat. One must also include indices of abundance, trophic diversity and composition, biomass, and sediment quality.

124. In spite of the fact that bioassays and other methods of bioevaluation in the laboratory are valid and efficacious tools for determining water-quality criteria, there must also be work on the direct evaluation, by means of ecological studies, of the effects of marine pollution on organisms. Detailed studies of the physical and chemical characteristics of industrial effluents and of the changes that occur in the environment after their discharge should also be carried out. Such studies would include exhaustive research in specific instances such as an oil spill, as well as programmes of long-range surveillance.

125. One important criterion is the decision as to which species to use in toxicity tests and assays. Some have noted the desirability of using sessile species, which offer the advantage of immobility and therefore will reflect the pollution or deterioration to which a specific area has been subjected. However, as some experiences have shown (personal communication from biologist Edgardo Gutierrez, INDERENA, Colombia), the depredation of these species, especially oysters, presents a problem of guaranteeing the permanence of the bioindicator. Likewise, with respect to mobile species, any decision should take into account factors such as whether they are demersal or pelagic species; of long or short life cycle and whether they are in a niche or region of limited life. It is also important to consider the reproductive strategies of the above-mentioned species, whether they have low or high fecundity, taking into account that sessile species of low fecundity run the highest risks.

126. The Food and Agricultural Organization (FAO) of the United Nations has suggested the use of species which also have some defined commercial or recreational value at the present time. The above-mentioned species are not necessarily good bioindicators of pollution. The idea is to utilize species that are more sensitive even if they do not have commercial value per se but can be part of the trophic chain of the commercial species. It is important to mention that it is necessary to carry out studies on the

bioaccumulation of pollutants by the species being considered, particularly with regard to pesticides and their metabolites and heavy metals present in the waste waters being discharged within the Region.

127. One of the operational problems in some countries of the region is that the organizations or bodies charged with protection of the coastal waters are not themselves free of the budgetary difficulties and limitations and the delays in execution natural to any administrative system and common to the economic conditions of the countries. There are times when expensive equipment is under-utilized or perhaps not even used at all for significant periods of time, owing to the lack of resources for the timely replacement of damaged or broken parts.

128. In other countries, the infrastructure is not in place, nor do they have the personnel needed for developing permanent programmes; therefore, it is necessary to develop simple methodologies. These methodologies would not be capital-intensive (using expensive and sophisticated equipment), but rather intensive in the knowledge incorporated, for which biological indicators (bioindicators) are very attractive. However, in some instances the identification of the species can be difficult even for species from the region, particularly in the case of invertebrates.

129. It is necessary to establish flexible methods for estimating pollution. These methods would help in determining the area of each zone or micro-region and the composition and/or relative importance of each of the contributing factors. Flexible methods will also help to improve standardization and follow-up on environmental quality. It is necessary to enhance the work pertaining to the identification of sources of coastal pollution, to quantify the problem and perhaps more importantly, to determine causes and measures of control. In the Southern Pacific, we have already had the experience of evaluating pollution in Colombia by two methods: questionnaires and applying coefficients and approximations in order to determine indirectly the contaminant levels for various activities. BOD, OOD, NOX, PO4, and SS were estimated in terms of equivalent population.

130. There are manuals such as those of PAHO which, combined with more technical and detailed documents in the field, allow a relatively approximate calculation of discharges. Within the scheduling of training activities, sponsors should include familiarization with the use of indirect estimation using conversion factors, and the design of survey and calculation formats, based on experiences in the Southern Pacific zone.

131. As a result of the process of indirect estimation, a programme should be established to categorize effluents and to set in motion the direct national measurement of discharges, with a view to dealing with those discharges identified as most critical. A factor critical for guaranteeing the reliability of these measurements is the statistical design for the collection of samples, plus the fact that in relative terms this is an expensive program, since it requires that field and laboratory equipment, qualified and suitable personnel, transportation, etc. be available.

132. The sources of coastal zone pollution are many. Among them are municipal waste water effluents (UNEP/ECLAC, 1982), industrial effluents, as well as other contaminants such as hydrocarbons, pesticides and agricultural chemicals that generally play an important part. As the various types and sources of coastal pollution in the countries of the region are identified, recognized and learned about, joint task forces between countries that share the same sort of problems can be established; hence, unnecessary duplication or parallelling of effort can be avoided.

133. We suggest that an updated inventory of the resources and infrastructure of each country in the region be made as soon as possible, so that the limitations, requirements for improvement of both equipment and personnel, and necessary modifications can be identified. All this would be aimed at defining the current requirements for training and economic resources.

134. The experience of the Southwestern Pacific is important in this regard, since faced with a lack of standards and the need for development of those standards, several regional and special courses have been offered, such as Basic Techniques and Methods for Performing Bioassays and Techniques for Specific Categories of Bioassay (Quick Tests and Effluent Toxicity). Steps have been taken to strengthen institutional capabilities (e.g. national laboratories).

135. Formal technical protocols need to be developed to cover specific issues such as types of species to test or assay, their characteristics (life cycles, behaviour, etc.), biological responses, and cultures (first or second generation), so that a standardized system of continuous feedback can be established.

136. There is one additional challenge for countries of the Wider Caribbean Region, and that is with regard to the solutions which we must decide on and implement to meet the need for pollution control. New, innovative, alternative, solutions must be proposed, distinct from those conventionally proposed and used. Examples of such solutions are the saving and efficient use of water (in order

to reduce the costs of supply and disposal), anaerobic treatment and recycling systems for waste water, and the use of by- and sub-products in ways such as aquaculture and hydroponic cultures of appropriate species. There have been many experiences in this regard to indicate the feasibility and desirability of such efforts.

137. For this, there is doubtless a need for research, technological development, political commitment and, above all, solidarity and shared labour on the part of all the countries of the region. The circumstances require it.

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The series of CEP Technical Reports contains selected information resulting from the various activities performed within the framework of the UNEP Caribbean Environment Programme (CEP). CEP was initiated in 1976 by UNEP with the assistance of ECLAC, at the request of the Governments of the region. A framework for regional projects and activities was first formulated in Montego Bay in 1981, when the Action Plan for the Caribbean Environment Programme was adopted by the First Intergovernmental Meeting.

The major legal instrument of CEP was adopted at the Second Intergovernmental Meeting, convened at Cartagena de Indias, in 1983: the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region. The Cartagena Convention provides a framework for the development of specific protocols.

The implementation of CEP is supported mainly by the Caribbean Trust Fund, established by the participating States and Territories. Their active participation is ensured through regular Intergovernmental and Contracting Parties Meetings, a rotating Monitoring Committee formed by representatives from nine States and Territories and through the National Focal Points. The principal focal point in each State or Territory is the ministry or department responsible for external relations or foreign affairs. Additionally, the agency responsible for the management of marine and coastal resources is the focal point for technical purposes.

Currently the Action Plan of CEP concentrates in six major areas for the management of marine and coastal resources: Overall Co-ordination, Specially Protected Areas and Wildlife (SPAW), Assessment and Control of Marine Pollution (CEPPOL), Integrated Planning and Institutional Development (IPID), Information Systems (CEPNET), and Education, Training and Public Awareness (ETA)

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The joint IOC/UNEP Marine Pollution Assessment and Control Programme for the Wider Caribbean Region - CEPPOL started in July 1990, following its approval by the UNESCO IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) at their third session in December 1989 and by the Fifth Intergovernmental and Second Contracting Parties Meeting of CEP, January 1990. CEPPOL currently concentrates on: (a) Control of Domestic, Industrial and Agricultural Land-based Sources of Pollution; (b) Baseline Studies on Pesticide Contamination and Formulation of Control Measures; (c) Monitoring and Control of the Sanitary Quality of Bathing and Shellfish Growing Waters; (d) Monitoring and Control of Pollution by Oil and Marine Debris; (e) Site-specific Studies of Damaged Ecosystems and Development of Proposals for Remedial Action; (f) Development of Environmental Water Quality Criteria; and (g) Research on the Significance of Organotin as Pollutant of the Wider Caribbean Region.