Caribbean Environment Programme

United Nations Environment Programme

UNEP

Intergovernmental Oceanographic Commission

Report of the CEPPOL Regional Workshop on Coastal Water Quality Criteria and Effluent Guidelines for the Wider Caribbean San Juan, Puerto Rico, 5-15 November 1990

Convened in co-operation with:

United States

Environmental Protection Agency (EPA)

CEP Technical Report No. 8

1991

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PREFACE

The present document reports on the results of the Workshop on "Coastal Water Quality Criteria and Effluent Guidelines for the Caribbean" that took place in San Juan, Puerto Rico, 5 - 15 November 1990 as part of the activities of the CEPPOL Programme.

The workshop was convened by the Intergovernmental Oceanographic Commission (IOC) and the United Nations Environment Programme (UNEP-CAR/RCU) with the collaboration of the U.S. Environmental Protection Agency (EPA) which provided the necessary funding and assistance for the preparation of the event.

The main purpose of the above-mentioned workshop was to consider a set of scientifically based environmental quality criteria suitable for the coastal environment of the Wider Caribbean Region. At present diverse environmental quality criteria are in use within the region and most of them are not based on sound scientific rationale and probably some are not appropriate for the tropical conditions of the region.

In order to discuss this situation, the regional experts convened for the regional workshop considered extensively the applicability of the environmental quality criteria adopted by the different countries of the Wider Caribbean Region. The regional experts also discussed the need to establish effluent guidelines specifically for the requirements of the planned negotiations of a regional protocol to control pollutants from land-based sources and for the implementation of the regional protocol on the specially protected areas.

As a result of the review of the environmental quality criteria that are being used in the region, the regional experts proposed interim environmental quality criteria for the coastal environment of the Wider Caribbean Region relevant to the use given to the coastal zone. Moreover, the regional experts also recommended proposals for the development of adequate environmental quality criteria, standards and effluent guidelines.

The above-mentioned recommendations will be implemented by national institutions of the countries and territories of the Wider Caribbean Region with the assistance of the joint IOC-UNEP CAR/RCU Secretariat as well as other relevant international or regional organizations.

This publication, the first of a series of reports to be generated by the CEPPOL Programme, is part of the UNEP/CEP Technical Reports.

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CEPPOL REGIONAL WORKSHOP ON COASTAL WATER QUALITY CRITERIA AND EFFLUENT GUIDELINES FOR THE WIDER CARIBBEAN

SAN JUAN, PUERTO RICO, 5-15 NOVEMBER 1990

REPORT OF THE MEETING

Introduction

1. The Third Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) (Caracas, 4 - 8 December 1989) and the Fifth Intergovernmental Meeting on the Action Plan for the Caribbean Environment Programme (Kingston, 17 - 18 January 1990) approved a major IOC/UNEP comprehensive regional programme for the assessment and control of marine pollution, denominated CEPPOL. The development of environmental quality criteria for the Wider Caribbean is one of the major activities envisaged within CEPPOL. Environmental quality criteria are among the most effective administrative tools providing for a rational approach to the protection of human populations and of critical ecosystems from deleterious effects of pollution. They are used, taking into consideration social and economic factors, for the formulation of primary national environmental quality standards determining the acceptable level of contaminants or damage to the ecosystems, as well as for the formulation of secondary standards, such as the effluent/emission standards.

2. A large variety of environmental quality criteria and standards exist at present in the Wider Caribbean region. Most of them are not based on sound scientific rationale and are not suitable for the tropical conditions of the region because they were adopted, without adequate review, from standards prepared for temperate climates (or waters). In order to remedy the situation, a programme for development of regionally applicable environmental quality criteria is urgently needed, specifically for the requirements of the planned negotiation of a regional protocol for control of pollutants from land-based sources and for the implementation of the regional protocol on the specially protected areas. To this end and as a preliminary activity envisaged within CEPPOL, this workshop was convened in San Juan, Puerto Rico, 5 - 15 November 1990.

3. The main purpose of the workshop was to review the existing environmental quality criteria and effluent guidelines used in the region, to discuss their suitability for application within the Wider Carribbean region, and to propose interim guidelines and criteria for immediate implementation as temporary measures. Additionally, the workshop was to propose the research and monitoring programme required for the development of the appropriate environmental quality criteria for the region, including guidelines for their application.

4. All the States and Territories of the Wider Caribbean were invited to participate at the Workshop. The Commission of the European Communities, as well as relevant international, intergovernmental and regional organizations were also invited to participate. The list of participants is appended as Annex I to this report.

Agenda item 1: Opening of the meeting

5. The meeting was opened on 5 November 1990, at 09:45 a.m. at the Government Reception Centre "Manuel Pavía Fernández" with inaugural addresses by Mr. Enrique Mandelli, IOC-UNEP CAR/RCU; Mr. William Matuszeski, Associate Assistant Administrator for Water, U.S. Environmental Protection Agency; and by Mr. Santos Rohena Betancourt, Chairman of the Environmental Quality Board of the Commonwealth of Puerto Rico. They all highlighted various aspects of the subjects to be covered during the meeting and outlined the general scope of the CEPPOL Programme. The EPA representative gave a brief presentation on the development of water quality criteria and effluent standards over the past 20 years in the USA. He stated that the success of this programme has been mainly due to the establishment of effluent guidelines, principally aimed at industries. He emphasized that water quality standards focus on water uses and stressed the importance of permit compliance and enforcement. Additionally, the Chairman of the Environmental Quality Board of the Commonwealth of Puerto Rico presented the US/EPA Clean Water Act and its applications with reference to local conditions, as some of the criteria are not suitable for Puerto Rico. He emphasized that the numeric standards must be the same or more restrictive than the national quality standards and that the promulgation of the water quality standards provides the local jurisdiction with the authority and the right to demand compliance of the criteria established by the State. Finally, Mr. William Beller, U.S. representative of the MAB Programme of UNESCO, highlighted the recommendations from a meeting on land-based sources of pollution in the Wider Caribbean Region, held in San Juan in July 1988 and emphasized the need to develop water quality criteria and standards as well as inventories on land-based sources of pollution and their effects.

Agenda item 2: Administrative arrangements

Agenda item 2.1: Adoption of agenda

6. The meeting adopted the agenda (IOC/UNEP-WQC-I/1) which is attached as Annex II to this report. The list of documents (IOC/UNEP-WQC-I/4) is appended as Annex III to this report.

Agenda item 2.2: Election of officers

7. The meeting unanimously elected the following officers:

Chairman:	Mr. Santos Rohena Betancourt, Chairman of the Environmental Quality Board of the Commonwealth of Puerto Rico, U.S.A.
1st. Vice-Chairman:	Mr. Dario Delgado, Panama
2nd. Vice-Chairman:	Mr. Jean François Boquet, France
Rapporteur:	Mr. James Parsons, Cayman Islands

Agenda item 3: Existing Effluent and Water Quality Criteria Guidelines and Standards

8. Mr. Carlos Fonseca, CEPPOL Consultant, presented the draft document "Environmental Quality Criteria of Coastal Areas in the Wider Caribbean Region - A Compilation" (IOC/UNEP-WQC-I/6 prov.), highlighting the differences between temperate and tropical areas in terms of biodiversity, wastewater disposal and degradation practices; and levels of technological development. Additionally, the social and economic differences were mentioned as an important aspect which needed to be taken into consideration. He emphasized the limitations of bioassays as artificial environments, the need for more studies on commercial species and recreational areas and the importance of sewage water reuse following appropriate treatment. Finally, a set of comparative tables were presented to the meeting summarizing the various water quality criteria and their application in 15 of the 33 States and Territories of the Wider Caribbean. All the participants were urged to provide comments in writing to the Secretariat prior to the finalization of the workshop, in order to update and complete the preparation of the final version of the document.

9. The various delegations presented their national programmes and experiences on coastal water quality criteria and standards. The US/EPA delegation gave a detailed presentation on the regulatory requirements of national water quality standards and EPA's responsibilities to procure compliance with such regulations. Additionally, the procedures to derive water quality criteria were outlined, as well as the establishment of recreational water quality criteria based on an epidemiological approach. EPA provided the meeting with the guidelines and standards for recreational/bathing waters. However, a question was raised regarding the applicability of these guidelines in tropical ecosystems due to temperature sensitivity of the indicator organisms. It was pointed out that tests in tropical ecosystems had not been performed yet and therefore the question of temperature sensitivity still remained unsolved. Other comments of general interest also included the need to develop sediment criteria as part of the national water quality criteria and the problems involved in the enforcement of this type of criteria.

10. Additionally, the concept of water quality criteria versus environmental quality criteria was pointed out. The problems arising from water quality criteria were recognized, as it bases observations and measures on only one ecosystem compartment and makes no allowance for environmental/ecosystem interaction. Therefore, it was suggested that field data of acute and non-acute toxicity, as it is called for in environmental quality criteria, provides more meaningful results in terms of intended use of the environment.

11. Following a general description of the major coastal target environments in their countries and the different types of pollutants reaching these water bodies, the representatives from Aruba, Trinidad and Tobago, Bahamas, Barbados and Jamaica commonly expressed that the standards for water quality being used in their countries are taken from WHO or US/EPA standards or from a combination of both, and emphasized that efforts are being made at the national level to develop legislation on these issues or to ensure its enforcement in case legislation had already been developed. The Netherlands Antilles and France informed that the standards from the European Economic Community are being used in their national waters

and suggested that these be compared with the US/EPA standards to review their suitability for and adaptability to the coastal waters of the region. Of particular interest was the presentation made by the representative of France on the water quality programme established by his country. This programme not only provides information on the quality of bathing waters but also provides the public with regular updated information on the status of their bathing waters by means of leaflets and maps. The representative from Colombia, Mexico and Panama briefly described the coastal water quality criteria and standards established in their countries, their implementation and level of enforcement. The representative from Honduras agreed with the majority of the participants in that their main problem regarding coastal water quality arises from sewage discharges, however, he highlighted that standards have not yet been established in his country. The representative from Cuba presented the various approaches being used in their country with respect to water quality criteria and effluent standards. She explained that national criteria were adapted from guidelines of european nations and international organizations. On the other hand, effluent standards had been established for particular and specific cases based only on the type and use of the receiving water body. The representative from Venezuela informed that the criteria developed in her country were also based on international guidelines and that the effluent standards established depend on the characteristics of the receiving waters. The norms and regulations being implemented nationally have resulted in very few years in almost 70% of the industries which were discharging effluents on the coastal waters to install secondary treatment plants. Furthermore, a representative from the Environmental Quality Board of the Commonwealth of Puerto Rico outlined the criteria and standards being used locally and which are based upon the principle of waterbody uses and on the requirements of the US/EPA. Additionally, a brief presentation was given on the Gulf of Mexico, its special characteristics and in particular on the activities of the U.S. Gulf of Mexico Programme.

12. The presentation of national water quality criteria was made by the participants to the workshop. This information is included in document IOC/UNEP-WQC-I/6.

Agenda item 4: Coastal Water Quality Criteria (Session I of the Workshop)

13. The Secretariat in collaboration with the Environmental Quality Board of Puerto Rico and based on the discussions under agenda item 3, briefly introduced the concept of control strategy by water quality criteria (limitations of the receiving waterbody, the problems of relating temperate and tropical water quality criteria) and the approach for the designation of the water bodies based on their uses.

14. As proposed by the Secretariat and in order to facilitate the discussions, the meeting agreed to divide into the following working groups according to the common uses of water bodies in the region: 1) Fish/shellfish protection and propagation; 2) Bathing waters; 3) Protected areas and wildlife refuge; and 4) Harbour/port and industrial areas. Subsequently, four working groups were established, each one composed of a chairman and a rapporteur.

15. Each group was requested to complete the compilation document as appropriate and to discuss each one of the following points: 1) review of the available water quality criteria for the particular target environment; 2) suitability for and adaptability to the region of the avail-

able water quality criteria; 3) considerations between site-specific versus regional criteria; 4) technical derivations of the quality criteria standards; 5) analytical methodologies for contaminant identification; 6) economic implications; 7) proposed interim quality criteria and standards for the region and their implementation strategy; and, 8) required research and monitoring programme to develop the appropriate quality criteria for the region.

16. Following almost three days of deliberations the working groups presented in plenary a report summarizing their discussions that included four major sections: 1) introduction; 2) brief analysis of the available water quality criteria and its applicability to Wider Caribbean waters; 3) set of proposed interim water quality criteria for the region, including rationale and proposed methodology; and 4) the outline of the programme required to develop appropriate water quality criteria for the region.

17. The working group on fish/shellfish protection and propagation recommended that in general terms the US/EPA criteria could be used until further studies are completed for tropical organisms, in particular coral reefs. Regarding fish consumption as it relates to human health implications, no specific criteria were recommended. The need to develop appropriate criteria for the region regarding human health was stressed and in this context, all countries of the region were encouraged to collect data on daily fish and water intake as well as population numbers, weight, life expectancy, etc., in order to provide the updated and required information to develop such criteria. Additionally, the meeting expressed concern with the problem of massive fish kills which occasionally occur in the region and suggested to develop as well a "contingency plan" for massive fish kills.

18. The working group on bathing waters explained that the priority consideration for these criteria was human health. In this context, two indicators were selected as the most significant for bathing related illnesses: E. coli and Enterococci, with recommended values as recorded in the report of their group. Recommended temperature and pH values were also provided as the main physical criteria. Additionally, aesthetic criteria were also suggested and related to debris, odors and turbidity. The working group recommended the implementation of epidemiological studies using several suggested indicators and the review of recent literature on public health, epidemiology and environmental microbiology. The meeting expressed concern regarding the temperature values provided by this working group and suggested that the temperature range should be given as $\pm 2^{o}C$ of ambient water temperature. It was also pointed out that some of the suggested indicators for the epidemiological studies are not simple or always feasible to carry out. Additionally, the issue of nutrient criteria and eutrophication was introduced by the meeting as an important one to consider for bathing waters. The working group explained that in their discussions the concept of aquatic life present in the water body was not considered as their main concern was human health, thus nutrients and their effects had not been taken into consideration.

19. The criteria for protected areas and wildlife refuge generated some discussion and it was agreed that given the different national policies and interests within each country on this issue, it was very difficult to recommend a set of regional criteria for protected areas. It was suggested that the guidelines provided by this working group could be used by each country as applicable. It was agreed that criteria for protected areas are very country specific, as in some

cases human populations are considered as part of the biosphere in which case human activities are allowed for and thus the criteria should be less stringent. At this point the concept of Environmental Impact Assessment was discussed and it was considered as a necessary but not an ultimate tool. In this context, the concept of environmental management was explained, with Environmental Impact Assessment (EIA) being one of the steps in the management sequence, which resulted in a management plan that should be monitored and assessed by the appropriate follow-up activities.

20. The criteria presented for ports/harbours and industrial areas generated three different positions from the meeting: 1) a minimum range of physio-chemical criteria should be recommended; 2) the criteria should be based on those applicable to marine life propagation, and 3) the criteria recommended needs to be based on those applicable to indirect contact. The final outcome of these three different positions was a minimum range of recommended criteria for immediate implementation for port/harbours and industrial activities in the area, along with a recommended programme for long-term implementation that will include more stringent criteria to allow for fish protection and propagation and indirect contact at a later stage. The concept of mixing zones was discussed and it was agreed that it should be included in the recommended long-term criteria.

21. The reports from each of the working groups as presented by the participants are appended as Annex IV of this report.

Agenda 5: Effluent Guidelines (Session II of the Workshop)

22. The Secretariat in co-operation with the Environmental Protection Agency (EPA) of the Government of the United States briefly introduced the concept of technology-based effluent limitations or standards and a general overview on the available standards and their implementation in the region. It was emphasized that in the development of the appropriate effluent guidelines for the region, it was necessary to consider innovative and alternative waste wate treatment methods, that are more suitable to the characteristics and conditions of most of the countries in the region. In this context, the development of anaerobic treatment and the use of biodigestors was suggested, as well as the establishment of small scale treatment plants scattered through the various towns rather than one plant serving a number of cities. These methods were highlighted as more efficient and cost effective, as not only the treatment was being performed but also the end products could be recycled or reused, such as water for irrigation, organic matter as fertilizer and methane gas as a source of energy. Additionally, the concept of saving water consumption, in particular for toilet flushing, was stressed and encouraged as one of the most efficient and simple means to facilitate wastewater treatment.

23. The participants were invited to present their national experiences on effluent guidelines and standards, in particular industrial and municipal effluent guidelines, including their implementation, monitoring and economic implications. The representatives from US/EPA presented an overview on the development, implementation and enforcement mechanisms on effluent guidelines in the USA. It was explained that their guidelines include pretreatment standards and apply to direct and indirect discharges. These guidelines include 51 industrial

categories which set limits for specific pollutants in the wastewater discharged. The concept of "Best Available Technology" is being applied for treatment of effluents, however, this concept refers specifically to the best available technology which is economically achievable. The development process for effluent guidelines in the USA takes approximately 6 years. Presently, there are 51 existing regulations for effluents and several others are under development. Specific regulations have been developed for industries and these are generally mass and concentration/based limits. The concentration/based regulations basically refer to BOD, total suspended solids (TSS), pH and a number of toxic substances. Among the best available treatments for direct discharges currently being used by industries, are steam-stripping and biological treatment for both ends of pipe and in the plant. Additionally, a summary of regulations for raw sugar cane processing refining and secondary treatment regulations in the USA were also presented. The secondary treatment standards have been defined based upon the performance of the existing technologies and their percent removal (except for nutrients). The US/EPA representatives provided the participants with a copy of the reports they had presented: "The Effluent Guidelines Programme: An overview, "Overview of the United States Water Pollution Programme and Major Environmental Laws", "OLPSF Regulation", "Briefing Paper-Secondary Regulation" and "Summary of Regulations for Raw Cane Sugar Processing and Cane Sugar Refining-Point Source Categories". A representative from the Environmental Quality Board of the Commonwealth of Puerto Rico presented the local concept of "mixing zones", which is defined by mathematical models and must comply with the esta-blished numeric water quality criteria and toxicity standards, including both acute and chronic toxicity. Additionally, the effluents discharging in the mixing zone must utilize the "best available technology" treatment for those effluents before discharging in the mixing zone.

24. The representative from Colombia and Mexico presented a general description of the effluent guidelines developed and being implemented in their countries, which have a different approach from those developed by the US/EPA. The representatives from Cuba and Venezuela in their previous presentation also outlined their national effluent guidelines and criteria used in their development.

25. The representative from CEHI informed that a survey on the operational status of sewage treatment plants is being conducted in 10 countries of the Lesser Antilles. The results of the survey will be published tentatively in March 1991. With reference to sugar cane processing, he indicated the need to establish standards for nutrient levels in the effluents, in addition to the BOD and SST already adopted. Moreover, the concept of water reuse from these operations should be seriously considered.

26. In order to facilitate the discussions and as proposed by the Secretariat, the meeting divided into the following working groups according to the most common types of discharges: 1) Domestic sewage (including those from tourist activities); 2) Sugar mills/refineries, rum distilleries and food processing; 3) Petroleum refineries, petrochemical plants, chemical and pharmaceutical plants and; 4) Mining and metallurgical activities.

27. All the working groups were asked to discuss each of the following points: 1) review of the available effluent guidelines and standards for the particular discharge; 2) suitability for and adaptability to the region of the available effluent standards and guidelines; 3) technical

derivations of the standards; 4) implementation strategies and required technologies; 5) analytical methodologies for contaminant identification; 6) economic implications; 7) proposed interim effluent guidelines and their implementation to be selected based on above discussions; 8) required research and monitoring programme to develop the appropriate effluent guidelines for the region; and 9) recommended pilot projects and legislation required.

28. Following the above-mentioned discussion each working group presented a report summarizing their deliberations and including the following sections: 1) introduction; 2) review of the available effluent guidelines and standards; 3) suitability and adaptability to the region of the available guidelines and standards; 4) proposed interim effluent guidelines and 5) recommended research, legislation and effluent limitations required to establish suitable effluent guidelines for the region.

29. The working group on technology based effluent guidelines and standards for domestic sewage discharges recommeded immediate and medium term actions. Among the former the following were considered: identification and qualification of all point sources of untreated and treated sewage disposal, if not available development of national legislation and enforcement to eliminate all discharges of untreated domestic waste waters; to stimulate the re-use of domestic waste waters; to discourage the disposal of waste waters and sludge at landfills and coastal areas, as well as, the human health effect of the unregulated disposal of waste water effluents and the establishment of public education and participation programmes. The medium term actions included the reduction of the level of BOD and TSS from the waste water to be discharged to 30 - 60 and 40 - 70 ppm, respectively, while the pH remaining between 6 - 9 and the temperature below 40 degrees C.

30. The working group on sugar mills/refineries, rum distilleries and food processing industries identified that these industries were widely distributed within the Wider Caribbean Region, however the available effluent guidelines were very limited. Therefore, the working group indicated the urgent need to establish the above-mentioned guidelines considering an assessment of the type of technologies that presently exist. To this end, the group attempted to identify the technologies considered the Best Practical (BPT) and Best Available (BAT) for the industry groups to be considered. The group then tried to determine what may be the most feasible options for future work towards establishing effluent guidelines for the industries considered by the work group, given the economic and technological capability of the countries of the Wider Caribbean Region.

31. The working group on petroleum refineries, petrochemical plants, chemical and pharmaceutical plants noted the existence of effluent guidelines in some of the Wider Caribbean countries. These guidelines were developed independently by each country and with their specific needs taken into consideration. In most cases the guidelines were industry specific and varied from one country to the other. The group suggested that an assessment of both technology-based treatment facilities and legislation applicable to the enforcement of effluent guidelines, be conducted. Research is also required to determine whether interim effluent guidelines will achieve the required water quality standards for impacted areas. The improve-

ment of existing effluent treatment technology in the region, thus bringing effluent discharges in line with water quality criteria for the receiving water bodies.

32. The criteria presented for mining and metallurgical activities considered that the extraction of minerals without proper environmental controls results in the release of large quantities of suspended solids, that adversely impacts pH, and can elevate the concentration of minerals being mined in the receiving water body to levels toxic to aquatic organisms. Furthermore, that there is a pressing need to perform an inventory and characterize the present mining and metallurgical practices used in region, emphasizing the waste water disposal practices. Recommendations on the best management practices to be adopted to prevent or reduce the pollution potential at a mine or plant site were also given. It was also suggested that more specific guidelines are needed for sand and gravel operations, bauxite and nickel mining, and precious metal mining and processing.

33. The reports of the working groups as presented by the participants are appended as Annex V to this report.

Agenda item 6: Review of reports from Sessions I and II and recommendations from the meeting

34. The meeting reviewed and considered the reports from Sessions I and II and provided amendments as reflected in Annexes IV and V of this report.

35. Based on the previous discussions, the meeting provided recommendations relevant to the deliberations of the workshop, which included implementation mechanisms for the recommendations and the required follow-up activities. The recommendations of the workshop are appended as Annex VI to this report.

Agenda item 7: Other Matters

36. No other matter was raised by the meeting.

Agenda item 8: Adoption of the report

37. The draft report of the meeting's deliberations was presented by the Chairman and it was adopted with additions and modifications as reflected in this document.

Agenda item 9: Closure of the meeting

38. The Chairman of the meeting, Mr. Santos Rohena, closed the meeting at 3:45 p.m. on 15 November 1990. Additionally, closing remarks were offered by Mr. Pedro Gelabert of US/EPA and by Mr. Enrique Mandelli on behalf of IOC and UNEP CAR/RCU. They thanked the participants for the success of the workshop and for their hard work during both sessions of the working groups. They encouraged the participants to convey the recommendations of the workshop to their governments and to assist as much as possible in the implementation

and follow-up of the recommended actions. Special thanks were given to US/EPA for the financial support of the workshop and to the staff of the Environmental Quality Board of the Commonwealth of Puerto Rico and the US/EPA of Puerto Rico for their assistance to the successful convening of the workshop and also for their friendship and kind hospitality.

ANNEXES

ANNEX I/ANNEXE I/ANEXO I

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ANNEX II

AGENDA

1. Opening of the Meeting

2. Administrative arrangements
   - 2.1 Adoption of the agenda
   - 2.2 Election of Officers

3. Existing Effluent Guidelines and Water Quality Criteria and Standards
   - 3.1 Regional Overview
   - 3.2 National programmes

4. Session I: Review of available Coastal Water Quality Criteria, and its suitability and adaptability to the region
   - 4.1 Concept and strategy
   - 4.2 Classifcation of water bodies and their designated uses
   - 4.3 Selection of working groups and discussion on quality criteria for particular target environments
   - 4.4 Working groups reports preparation (Session I)

5. Session II: Effluent Guidelines
   - 5.1 Concept of technology-based effluent limitations
   - 5.2 National experiences on development and implementation of effluent guidelines
   - 5.3 Selection of working groups and discussion on effluent standards as per type of discharge
   - 5.4 Working groups reports preparation (Session II)

6. Review of reports from Sessions I and II and recommendations from the meeting.

7. Other Matters

8. Adoption of the report

9. Closure of the meeting

ANNEX III

List of Documents

Working Documents

IOC/UNEP-WQC-I/1	Agenda
IOC/UNEP-WQC-I/2	Annotated agenda
IOC/UNEP-WQC-I/3	Report of the Workshop
IOC/UNEP-WQC-I/4	List of documents
IOC/UNEP-WQC-I/5	List of participants
IOC/UNEP-WQC-I/6	Environmental Quality Criteria of Coastal Areas in the Wider Caribbean Region - A compilation

Reference Documents

1.	EPA, November 1980	"Water Quality Criteria Documents; Availability," Federal Register, Vol. 45, No. 231, pages 79317-79379 (English only)
2.	EPA, June 1985	Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses (English only)
3.	EPA, September 1988	Introduction to Water Quality Standards (English only)
4.	EPA, May 1987	Quality Criteria for Water, 1986 (English only)
5.	EPA, September 1988	State Water Quality Standards Summaries (English only)
6.	University of the Virgin Islands, 1989	Proceedings of the Virgin Islands Water Resources Conference, July 24 - 26 1989 (English only)
7.	EPA, January 1990	Reference Guide to Water Quality Standards for Indian Tribes (English only)
8.	EPA, April 1990	Biological Criteria: National Program Guidance for Surface Waters (English only)

Reference Documents

9.	EPA, date unknown	Overview of the National Effluent Guidelines Program (industrial waste water discharges) (English only)
10.	UNEP, 1984	GESAMP: Principles for developing coastal water quality criteria. UNEP Regional Seas Reports and Studies No. 42 (English and Spanish only)
11.	IOC, 1987	IOC/UNEP/IMO Group of Experts on Effects of Pollutants Fourth Session, Paris 7 - 11 December 1987. IOC Reports of Meetings of Experts and Equivalent Bodies (English only)
12.	IOC, 1986	IOC Workshop on the Biological Effects of Pollutants, Oslo, Norway, 11 - 29 August 1986. IOC Workshop Report No. 53 (English only)
13.	IOC, 1988	Second IOC Workshop on the Biological Effects of Pollutants, Bermuda, 10 September - 2 October 1988. IOC Workshop Report No. 61 (English only)
14.	EPA, September 1988	Technical Publications Availability Report/Industrial Technology Division (English only)
15.	EPA, August 1989	Summary of Federally Promulgated Water Quality Standards Action (English only)
16.	IOC, 1990	IOC/UNEP Regional Workshop to Review Priorities for Marine Pollution Monitoring, Research, Control and Abatement in the Wider Caribbean Region, San José, Costa Rica, 24 - 30 August 1989. IOC Workshop Report No. 59 (English and Spanish only)
17.	IOC, 1990	Marine Pollution Assessment and Control Programme for the Wider Caribbean Region - CEPPOL. IOC Workshop Report No. 59 Part 2 (english, French and Spanish)

18. CEPIS, 1987 — History and Application of Microbiological Water Quality Standards in the Marine Environment. Water Science Technology, Vol. 18, No. 11, 1986. (English and Spanish only)

19. EEC, 1989 — Commission Proposal for a Council Directive Concerning Municipal Waste Treatment. Official Journal of the European Communities No. C 300 of 29 November 1989. (English only)

20. WHO, 1977 — Health Criteria and Epidemiological Studies Related to Coastal Water Pollution, Athens, 1 - 4 March 1977. (English only)

ANNEX IV

REPORT OF THE WORKING GROUPS, SESSION I

GROUP I: WATER QUALITY CRITERIA FOR PROTECTION AND PROPAGATION OF FISH AND SHELLFISH

1. Introduction

The work group responsible for dealing with the protection and propagation of fish and shellfish approached the problem from the standpoint of protection of aquatic organisms as constituents of regional ecological communities. Although a separation of aquatic life protection and propagation, commercial and ecological aspects were discussed, the group considered that the primary objective at this point should be the protection of aquatic life and not just those species that are of commercial value. The recommendations made concerning the criteria to be used and those to be developed for the region are directed towards this primary objective. Such criteria will serve as a basis to develop standards and control mechanisms that will assure a balanced development and exploitation of the aquatic resources in the region, such as long-term economic assets (i.e. tourism, commercial and recreational fishing). In addition, water quality criteria are intended to establish water quality objectives for water bodies and serve as a basis for assessing the current quality of water.

The effect on human health as result of consumption of the aquatic life was considered in general terms. Due to the absence of data within the region of many of the human exposure factors used in determining human health the group did not recommend any regional criteria that addresses this concern. However, research is recommended to allow each country in the region to gather data to be used for the development of regional health criteria,based upon a compilation of the country specific information that may be generally available.

The research recommended is directed towards certain specific areas that the group believe require additional information to permit reasonable and acceptable criteria to be developed for the region.

2. Review of Available WQC:

Water quality criteria for aquatic life protection have been developed by the World Health Organization (WHO), European Economic Communities (EEC) and U.S. Environmental Protection Agency. The US/EPA criteria and methodology for criteria derivation were reviewed for applicability to protection of Caribbean fish and shellfish. Other methodologies and criteria were not reviewed because this information was not available.

The US/EPA water quality criteria are principally derived from published and new laboratory data on acute and chronic toxicity and bioaccumulation potential of substances to freshwater and marine organisms. Minimum data requirements for derivation of both

freshwater and marine criteria ensure data on representatively sensitive species and life-stages are available before criteria are derived. Criteria concentrations are recommended to protect aquatic life from acutely lethal effects and on chronic effects on aquatic life and its uses; i.e., marketability or use as prey for wildlife. When toxicity of a substance is dependent upon water quality, the criteria include adjustments for hardness, pH or temperature if appropriate. Field data are used when available and scientifically defensible.

Water quality criteria for the protection of Caribbean fish and shellfish should consider unique conditions and communities of aquatic organisms found in Caribbean water bodies. Although Caribbean aquatic species do not comprise a significant proportion of data on species sensitivity, as found in US/EPA criteria documents, families and genera of Caribbean and Gulf of Mexico species may be well represented in this database. It is probable that an analysis of this information could provide assurance that the sensitivities of Caribbean species are not unique and that U.S. EPA WQC are reasonable for use in the Caribbean region. Absence of data on the sensitivities of corals is of particular concern.

Available water quality criteria for the protection of human health from ingestion of fish, shellfish, and drinking water currently are derived from regional determinations of certain human exposure factors such as life expectancy, average weight, fish and shellfish daily consumption, and daily water intake. Such is the case for human health criteria developed by the EPA. Considering that the human exposure assumptions used in values the establishment of these criteria may be significantly in the Wider Caribbean, a consensus was reached that existing values for the protection of human health should not be applied to the region.

3. Proposed Interim WQC for the Region, Rationale and Methodology

3.1 Adoption of US/EPA freshwater and saltwater aquatic life criteria on an interim basis is recommended (See Table 1). Adoption of final aquatic life criteria should occur after examination of the technical basis, including data used and criteria derivation methodologies of EPA, WHO, and EEC. In addition, final criteria should not be adopted until an analysis of existing data on the comparative sensitivities of all species used by EPA to derive WQC and Caribbean species is completed. This comparison should include where possible analysis of "Final
Acute Values" calculated using the recalculation option, most sensitive family representing Caribbean species vs. other families, and a compilation of all species sensitivity data.

We recommend the criteria of non-degradation of ecosystems be applied to the parameters for which there are no water quality criteria. The Work Group notes, that some environmental parameters of concern include: temperature, salinity, dissolved oxygen (salt water), BOD, and nutrients.

3.2 No specific WQC for the protection of human health through the consumption of fish and shellfish are recommended, until further evaluation and analyses of regional specific data are carried out. The work group suggests, however, that water quality criteria indicative of sewage contamination or shellfish toxicity be utilized.

The internationally agreed levels for faecal coliform (200 CFU/100 ml) in the water column should be used for sewage contamination. When tests are fully developed by EPA and NOAA, to determine human specific indicators, the indicators derived could be considered for the protection of human health.

Shellfish toxicity paralytic (PSP), diaheritic (DSP), neurological (NSP) and amnesic shell fish poisoning (ASP) is caused by a number of microalgae species (Gymnodinium sp., Alexandrium sp., Perydinium sp. and Nitzchia sp.). The group recommend that water column concentrations (cells/l) of microalgae species be used as criteria for shellfish toxicity where available. For Gymnodium sp. the state of Florida criteria for Gymnodium breve (5000 cells/l) should be used. There are no water quality criteria as yet for Alexandrium tamarense or catinella but a mouse bioassay (80 mouse units) is used for testing shellfish tissue for human consumption in the New England States. Unfortunately as yet there are no water quality criteria (cells/l) or tissue assay standards for Perydinium bahamense var. compressum causing PSP in the Caribbean and Nitzchia pungens causing ASP. Dinophysis sp. causes DSP in aquacultured shellfish in Europe. The EEC uses a water column concentration of 600 cells/l for this organism and a similar standard could be applied for this organism in the Caribbean.

3.3 Each country should classify all coastal waters according to specific uses.

3.4 Whole effluent toxicity testing should be used where feasible to ascertain potential toxic impacts and to determine appropriate control mechanisms to reduce toxicity to acceptable levels.

Available resources for the investigation of oil spills and hazardous substances should be used to investigate massive fish kills in the region in a timely matter to determine their cause. Protocols should be developed for sampling and analysis in these events. Results of these analysis may serve to confirm reasonableness of criteria recommended for the Caribbean in this report.

4. Outline of the Programme Required to Develop the Appropriate Water Quality for the Region

4.1 Human health

a. Each country in the Wider Caribbean shall determine country specific data (daily fish and shellfish intake, life expectancy, average weight) to apply to EPA methodology in determining appropriate water quality criteria to protect human health from ingestion of toxics via consumption of fish and shellfish. This task should be given a high priority.

b. Once these data are available from each country, regional criteria should be developed using US/EPA methodology.

4.2 Aquatic life

a. In depth technical review is needed of the methodologies used by the U.S. Environmental Protection Agency, World Health Organization and European Economic Community to determine which is more technically defensible from a scientific basis and from a regional species protection basis. In addition, thorough reviews of existing acute toxicological data sensitivities of Caribbean (including Gulf of Mexico) vs. non-Caribbean families and genera of freshwaters and marine species should be compared.

b. On the basis of the above assessment, if sensitivities are similar, the most technically defensible criteria methodology should be used. However, if sensitivities are not similar, if there is no Caribbean and non-Caribbean organism of the same family or genera, or if there is a paucity of data, the existing criteria cannot be used.

c. Establish regional water quality monitoring network to determine substances of concern to the Wider Caribbean.

d. Following identification of substances of concern, basic research should be performed to determine water quality criteria for parameters in cases where organism sensitivities are not similar, there is a paucity of existing data or if toxicity data does not exist on Caribbean and non-Caribbean organisms of the same family and genera, or if there is no water quality data of concern. One such case is dissolved oxygen.

e. Basic research should be undertaken to develop methods to evaluate the sensitivity of corals to substances of concern such as pesticides, hydrocarbons and other chemicals which are widely used in the Caribbean.

f. Establish a regional laboratory network to pool available resources and expertise for sample analysis minimizing unnecessary duplication of equipment and providing cost-efficient and state of the art analytical resources to all nations of the Wider Caribbean.

Table 1

Recommended Interim Water Quality Criteria
For Freshwater and Saltwater
For the Protection of Aquatic Life

Compound	Freshwater		Saltwater	
	B1 Acute (ug/l)	B2 Chronic (ug/l)	C1 Acute (ug/l)	C2 Chronic (ug/l)
Aluminum[1]	750	87	69	36
Ammonia	-	-	-	-
Arsenic	360	190	69	36
Cadmium	3.9*	1.1*	43	9.3
Chromium III	1,700*	210*		
Chlorides	860,000	230,000		
Chlorpyrifos	0.083	0.041	0.011	0.0056
Copper	18*	12*	2.9	2.9
Chlorine, Residual	19	11	13	7.5
Lead	82*	3.2*	220	8.5
Mercury	2.4	0.012	2.1	0.025
Nickel	1,400*	160*	75	8.3
Selenium	20	5	300	71
Zinc	120*	110*	95	86
Cyanide	22	5.2	1	1
Pentachlorophenol	20**	13**	13	7.9
Parathion	0.066	0.013		
Lindane[2]	2	0.08	16	
Chlordane[2]	2.4	0.0043	0.09	0.004
DDT and metabolites[2]	1.1	0.001	0.13	0.001
Dieldrin[2]	2.5	0.0019	0.71	0.0019
Endosulfan[2]	0.22	0.056	0.034	0.0087
Endrin[2]	0.18	0.0023	0.037	0.0023
Heptachlor[2]	0.52	0.0038	0.053	0.0036
Heptachlor Epoxide[2]	0.52	0.0038	0.053	0.0036
PCB-1242[2]		0.014		0.03
PCB-1254[2]		0.014		0.03
PCB-1221[2]		0.014		0.03
PCB-1232[2]		0.014		0.03
PCB-1248[2]		0.014		0.03
PCB-1260[2]		0.014		0.03
PCB-1016[2]		0.014		0.03
Toxaphene	0.73	0.0002	0.021	0.0002

Footnotes:

1. Criteria valid for pH 6.5 - 9.0

2. Aquatic life criteria for these compounds were issued in 1980 utilizing the 1980 Guidelines for criteria development. The acute value shown are final acute values (fav) and according to the 1980 Guidelines the Acute values were intended to be interpreted as instantaneous maximum values, and the chronic values shown were interpreted as 24 - hour average values. EPA has not updated these criteria pursuant to the 1985 Guidelines. However, as an approximation, dividing the final acute values in columns B1 and C1 by 2 yields a Criterion Maximum Concentration. No numeric changes are required for columns B2 and C2, and EPA suggests using these values directly as Criterion Continuous Concentration (Table 1).

*Freshwater aquatic life criteria for these metals are expressed as a function of total hardness (mg/l). (Values displayed in Table 1 correspond to a total hardness of 100 mg/l).

** Freshwater aquatic life criteria for pentachlorophenol are expressed as a function of pH. (Values displayed in Table 1 correspond to pH 7.8).

References:

Quality Criteria for Water - 1986
USEPA, 1986

Federal Register, 1987, 1988 and 1989

GROUP II: WATER QUALITY CRITERIA FOR BATHING WATERS

1. Introduction

Bathing waters of the Caribbean serve the recreational and economic needs of the populations. When these waters are polluted, they affect not only the human health of the bathers but also the economic health of the tourist trade.

For these reasons, the suggested water quality criteria (WQC) include the bacteriological, chemical and physical factors involved in human health. The WQC also include the aesthetic considerations that figure heavily in the tourist use of bathing waters.

The suggested WQC apply to the saline waters of the coastal zone, estuarine waters, and fresh surface waters. Seldom do any of these waters, or portions of them, serve only the needs of bathers. Other concurrent uses may include recreational fishing, commercial fishing, seaweed harvesting, protected areas for fish/shellfish protection and propagation, wildlife refuges and marine parks.

It is expected and true that though the human body can easily resist contact pollution, the human system readily falls prey to ingested pollution, say through eating contaminated finfish or shellfish. When through swallowed water or exposure to water dictates the WQC for bathing waters, the human health criteria may be less stringent than those for other concurrent water uses.

On the other hand, WQC obtained on the basis of the economic value of tourism, and the need to have aesthetically pleasing bathing waters, may be the more stringent criteria. As indicated above, the derived water quality standards should be the envelope of the strictest criteria recommended for all concurrent uses of the water body.

The Sections that follow comprise (1) a review of the available WQC and Standards for bathing waters, including their applicability to Caribbean waters; (2) proposed interim WQC, including the rationale for choosing them; (3) and the research needs for improving these WQC for the region.

2. Review of available WQC and Standards

2.1 Bacteriological criteria

The findings of this review have indicated that bacteriological criteria are the most important criteria from a human stand-point for bathing waters. In this report, bathing waters are defined as waters of both saline and non-saline characteristics and the criteria do not involve any consideration for aquatic life that may be present in these waters. The primary considerations are based on the use of the water resource and in this case it is <u>bathing</u>.

Six microbiological indicators are used internationally for setting bathing water criteria and standards. On review, three (3) were found to be significant and important in monitoring the quality of bathing waters (See Table 1).

Significant and important bacteriological criteria

(1) Fecal coliforms
(2) Enterococci
(3) E. coli

Fecal coliforms. "Although there is no demonstrable correlation between fecal indicators and pathogens, except for Salmonella, several countries have introduced norms of bacteriological quality based upon the faecal coli index." Also " . . . criteria for bathing, like those for other uses such as fisheries, should ideally be based upon well founded dose-response relationships." (Reference: UNEP Regional Seas Reports and Studies No. 42., p.11)

The above quotation and the values presented in Table 1 suggest the general usage values in terms of fecal coliform indicators as guidance for bathing waters in the countries reviewed. The 1976 EPA recommended criteria coincide with most of these values and apparently most of these values were adopted from EPA usage value for fecal coliform in bathing waters. (Reference: EPA, Quality Criteria for Water 1976).

The current usage value for bathing water quality in terms of fecal coliforms for most countries is 200 CFU/100 ml; 10% of the values can exceed 400 CFU/100 ml.

Based on present research by EPA and others, the criteria for bacteriological water quality should be based on a dose-response relationship, i.e., the effect of water quality on bathers' health.

Enterococci and E.coli.

Enterococci and E. coli have been proposed as better indicators than fecal coliforms. The general suggested guideline for enterococci levels in waters used for bathing is 35 CFU/100 ml (Table 1), this proposal being based on dose response relationships. The rationale is dealt with in detail in Section III of this report.

Ref. Health Effects Criteria for Marine and Recreational Waters, Victor J. Cabelli, EPA 600/1-80-031, August 1983

The other three (3) criteria are:

(1) Total coliforms
(2) Fecal streptococci
(3) Enteroviri

(1) Total coliform count is not considered as good a criteria as fecal coliform since total coliform count includes many organisms of non-fecal origin.

(2) The fecal streptococci indicator was not used on the basis that enterococci were better representatives than streptococci of faecal origin with respect to water quality used for bathing.

(3) Enteroviris was not used on the basis of the costs, time and complexity involved in their determination.

Table 1

Review of Regional Water Quality Criteria
Bathing Waters (Fresh & Saline)
Bacteriological Criteria*

Region/Source	Faecal Coliforms (CFU/100ml) [1]	Enterococci (CFU/100ml)
Barbados	200	--
Colombia	<200	--
Cuba	<200	--
E.E.C. [2]	80% < 100; 95% < 2000 [3]	90% < 100[3]
E.P.A. [4]	200; 90% < 400 [5]	35 [6]
Jamaica	200	--
Mexico	200; 90% < 400	--
Puerto Rico	≤200	35 [6]

*Criteria above (a) take no account or consideration for aquatic life forms; (b) are based on a minimum of not less than five samples taken over a 30-day period, the level should not exceed a log mean of the indicated figure per 100 ml.

[1] C.F.U. - Colony Forming Units
[2] E.E.C. - European Economic Community
[3] Guide and mandatory limits respectively
[4] E.P.A. - Environmental Protection Agency (U.S.A.)
[5] Quality Criteria for Water, 1976
[6] Fresh Water Criteria, "Ambient Water Quality Criteria for Bacteria-1986." EPA 440/5-84-002 January, 1986. Also from this reference:

Fresh water criteria: E.Coli 126 CFU/100ml for designated beach, Single sample 235 CFU/100ml, Enterococci 33 CFU/100ml.

Marine water criteria: Enterococci 35 CFU/100ml for designated beach, Single sample 104 CFU/100ml.

2.2 Physical-Chemical criteria

Two (2) physical-chemical criteria are important in the quality of water used for bathing, namely:

(1) pH
(2) Toxic Substances

The reviewed pH criteria are presented in Table 2. It is noted that there is not much variation in the listed values with a large percentage of the pH ranges being similar.

Toxic substances play an important role in the quality of bathing waters and should be considered in developing and establishing criteria.

2.3 Aesthetic criteria

Aesthetic criteria for bathing water are very important as visual perception may determine level of use and in many cases level of income generated from these sources.

In the region there exist no uniform accepted set of aesthetic criteria. This is not unreasonable because such criteria tend to be subjective and descriptive.

References for item 2:

BARBADOS	World Health Organization Standards
COLOMBIA	Código de Recursos Naturales
CUBA	Norma Técnica Cubana No. 93.07 Higiene Comunal, Junio, 1986
E.E.C.	Directive 75.160, December 8, 1989
E.P.A.	Quality Criterias for Water, 1986 U.S. Environmental Protection Agency, Washington, D.C.
JAMAICA	Localized Operational Values
MEXICO	Diario Oficial de la Federación
PUERTO RICO	P.R. Water Quality Standards Regulations 1990 Environmental Quality Board

Table 2

Review of Regional Water Quality Criteria
Bathing Waters (Fresh & Saline)
Physical-Chemical Criteria

Region/Source	pH
Barbados	7.0 - 8.5
Colombia	5.0 - 9.0
Cuba	6.1 - 8.9
E.E.C. [1]	6.0 - 9.0
E.P.A. [2]	6.5 - 8.3
Jamaica	6.5 - 8.5
Puerto Rico	7.3 - 8.5

Note: Criterion above take no account or consideration for aquatic life forms

[1] E.E.C. - European Economic Community

[2] E.P.A. - U. S. Environmental Protection Agency

3. Proposed Interim WQC for the Region (Rationale and Methodology)

3.1 General Water Quality Criteria (Aesthetics)

All waters should be free of substances either discharged or discarded that settle to form objectionable deposits or float as debris, scum or other matter to form nuisances. These materials include wood, plastic, bottles, cans, tar balls.

Any oil sheen on the water surface is considered objectionable from an aesthetic point of view.

The waters should be free from substances that cause objectionable color (eg. dyes), odor, taste, foam (eg surfactants) or turbidity attributable to discharges, in such a degree to be a nuisance to the enjoyment of the existing or designated uses of the water body.

(For swimmers' safety the water column visibility should not be less than 2 meters.)

3.2 Health criteria

3.2.1 Bacteriological criteria recommendation

The bacteriological criteria recommendations are in the form of two (2) graphs (figure 1 and 2) and a table (table 3) which shows the various parameters and strength of the relationships shown. These graphs are based on the relatively new bacterial indicator systems, E. coli and enterococci. As a point of reference, the commonly used indicator, fecal coliforms, is also shown at an approximate equivalent point of 200 CFU/100 ml. It has been suggested that indicators consistent with this level of fecal coliforms are:

	Gastroenteritis rate per 1000 Swimmers	Steady State Geometric Mean Indicator Density (CFU/100Ml)
Marine Water		
Enterococci	19	35
Fresh Water		
Enterococci	8	33
E.coli	8	126

The fecal coliform indicator does not follow the relationship shown on the graphs and cannot with validity be so interpreted.

To use the charts, an acceptable swimming-associated gastroenteritis rate per 1000/swimmers (i.e. those persons who immerse their faces in the water) must be selected. By use of the graph the corresponding geometric mean of the relevant indicator is shown. Conversely a review of the indicator geometric means from monitoring data for a beach can be used to estimate the incidence of swimmer illness that has occurred.

For marine waters it has been estimated that at a geometric mean fecal coliform density of 200 CFU/100ml there is a swimming associated gastroenteritis rate of about 19 per 1000 swimmers. This is a commonly used bacteriological limit in many countries.

The fecal coliform indicator has been shown not to correlate with swimmer illness and therefore has only limited application in judging a water's acceptability.

There are several reasons supporting the use of the enterococci and E.coli indicators including the fact that they are more feces specific, and that they show significant correlation to gastroenteritis in swimmers. Being able to assess the illness risk for swimmers is a powerful public health protection tool.

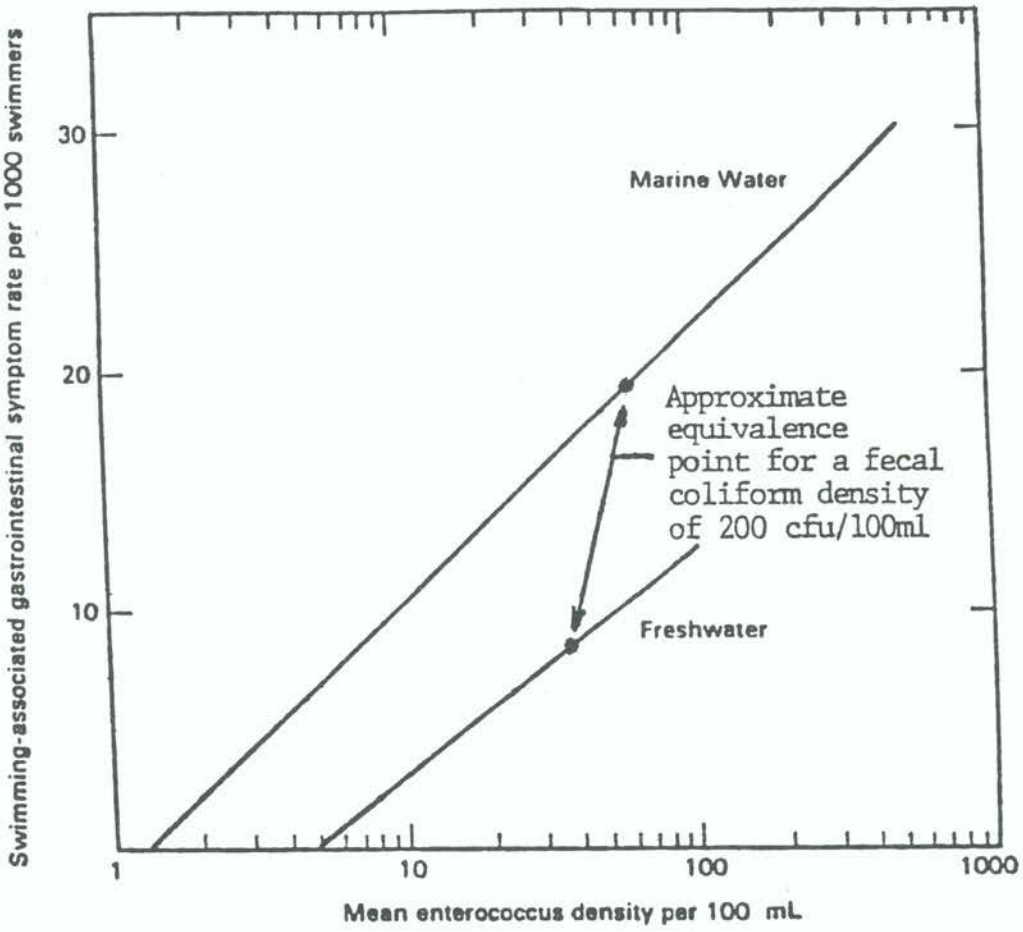

Figure 1. Marine and freshwater criteria for swimming-associated gastrointestinal illness and water quality using enterococci to measure the water quality.

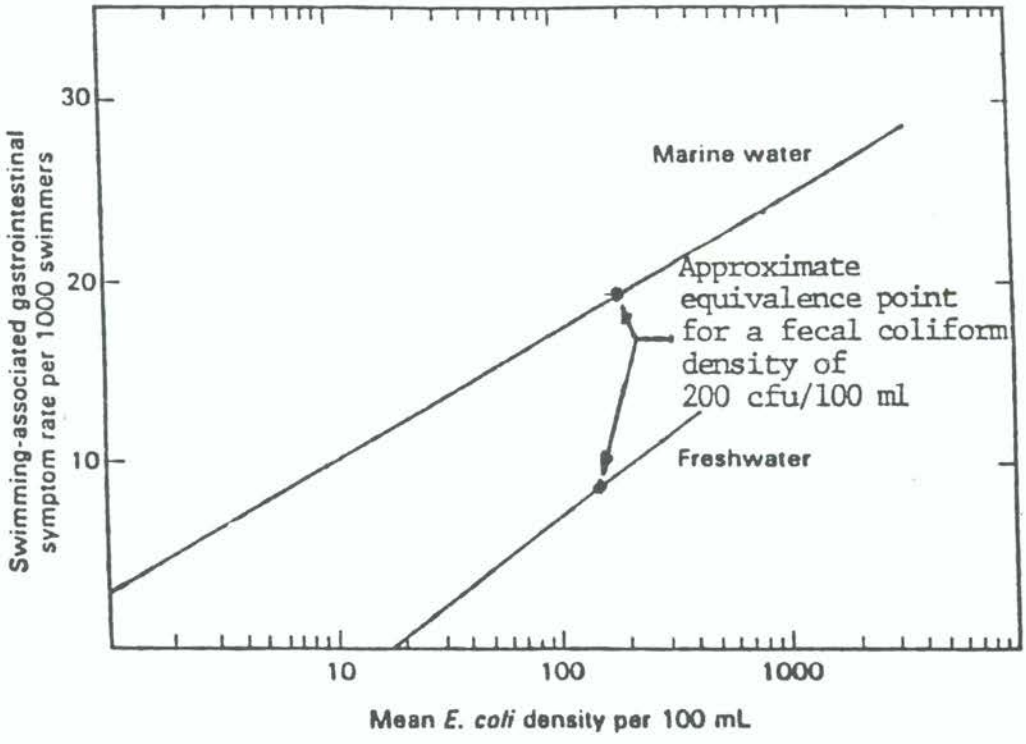

Figure 2. Marine and freshwater criteria for swimming-associated gastrointestinal illness and water quality using *E. coli* to measure the water quality.

Table 3

Summary of Statistics Related to Marine and Freshwater Criteria for Highly Credible Swimming-Associated Illness and Water Quality Indicators, *E. coli* and Enterococci

Type of Water	Mean Swimming-Associated Illness Rate	Geometric Mean Density		Slope		Standard Error Est.		Correlation Coefficient	
		EC[1]	ENT[2]	EC	ENT	EC	ENT	EC	ENT
Marine[3]	15.2	56	25	7.3	11.6	8.5	6.7	.512	.712
Fresh	5.7	72	20	9.4	9.4	2.5	2.8	.804	.744

[1]EC - *E. coli.*
[2]ENT - enterococci
[3]Illness rates and bacterial indicator density data obtained from Reference 1

As noted in the research portion of this report, the correlations developed were specific for temperate climates. While these correlations should be confirmed for tropical conditions, a prudent public health approach would recommend use of the charts pending more definitive tropical water studies.

The bacteriological criteria recommended here must be presumed to be a correct statement of the health risk to swimmers unless a survey of all pollution sources indicates that the bacteria are not of human origin. Human sources of concern include untreated sewage discharges, treated sewage discharges, improperly functioning septic tank systems, marinas and frequent passage of boat traffic nearby which may not have holding tanks for sanitary wastes.

Properly conducted surveys will indicate the source of the indicator bacteria whether of human or from other warm blooded animals. Knowledge of such sources also provides control points for reducing indicator bacterial densities on the beaches. If human sources are not identified then the significance of indicated disease risk may be overstated and higher indicator bacterial densities tolerated.

The references for these criteria, figures 1 and 2 and table 3 follow:

1. Cabelli, V.J. Health Effects Criteria for Marine Recreational Waters. EPA 600/1-80-031 August, 1983.

2. Dufour, A.P. Health Effects Criteria for Fresh Recreational Waters. EPA 600/1-84-004 August, 1984.

3. Ambient Water Quality Criteria for Bacteria-1986. EPA 440/5-84-002 January, 1986.

3.2.2 Physical and chemical criteria

(a) pH

Recommended criteria: Marine & Coastal Waters: 6.5 - 8.3
Fresh Waters : 5.0 - 9.0

Rationale:

This criterion is based on the sensitivity of the human eye to change in external pH. The lacrimal fluid of the human eye has a normal pH of approximately 7.4 and a high buffering capacity due primarily to the presence of complex organic buffering agents. When the lacrimal fluid, through exhaustion of its buffering capacity, is unable to adjust the immediate contact layer of another fluid to a pH of 7.4, eye irritation results. A deviation of no more than 0.1 unit from the normal pH of the eye may result in discomfort, and appreciable deviation will cause severe pain. Ideally, the pH of swimming water should be approximately the same as that of the lacrimal fluid i.e., 7.4. However, since the lacrimal fluid has a high buffering capacity, a range of pH values from 6.5 to 8.3 can be tolerated under average conditions. If the water is relatively free of dissolved solids and has a very low buffering capacity, pH values from 5.0 to 9.0 may be acceptable to most swimmers. Hence, eye irritation is minimised and recreational enjoyment enhanced by maintaining the pH of coastal and marine waters used for bathing within the range of 6.5 and 8.3, and for waters, which has a low buffer capacity, within a range of pH 5.0 and 9.0, which may be tolerated.

Analytical methodology as outlined in Standard Methods for the examination of Water and Wastewater, 1985, APHA-AWWA-WPCF.

(b) Temperature:

Recommended criteria:

No heat should be added to waters which would cause the temperature at any site to exceed 33°C (91°F).

Rationale:

Physiologically, humans will not experience thermal stress under modest metabolic heat production as long as the water temperature is lower than the normal skin temperature of 33°C.

(c) Toxic Substances

The waters should not contain any substance or substances at levels that are harmful alone or combined to human health as caused by direct body contact or ingestion through use of the water for bathing.

4. An Outline of the Programme Required to Develop Appropriate Water Quality Criteria for the Region

A prospective epidemiological study should be conducted in the Caribbean area to determine the relationship between swimming-associated illness and the densities of various indicators of water quality. Prior to beginning the study a thorough review of the recent literature in the fields of public health, epidemiology and environmental microbiology should be conducted. It is envisioned that the study would be similar to the studies conducted by Cabelli (1983), and Dufour (1984), with modifications made to reflect the findings of the literature review.

The studies conducted by Cabelli, in saline waters and Dufour, in fresh waters have provided much of the data that demonstrate a dose response relationship between certain indicators of fecal pollution in bathing waters and illnesses in persons swimming in the waters. These studies were conducted at matched pairs of swimming beaches that varied widely with regard to pollution levels. One being barely acceptable according to the standard of 200 fecal coliforms/100 ml and the other being "relatively unpolluted." The occurrences of gastrointestinal illness, and information on irritations and disturbances of the skin, upper respiratory tract, eyes and ears in swimmers and non-swimming control subjects were obtained for the period of 10 days following their visit to the beach.

During the exposure period, samples of the water were collected and analyzed for the following indicators of fecal pollution:

Enterococci
Escherichia coli
Klebsiella
Enterobacter-Citrobacter
Pseudomonas aeruginosa
Aeromonas hydrophila
Vibrio parahaemolyticus
Fecal coliforms
Total coliforms
Clostridium perfringens
Staphylococci

Illness rates that were observed between the swimmers and the controls were compared to determine the rate of excess illness that could be attributed to swimming. The excess rates were plotted against the concentrations of the various indicator organisms occurring in the waters and correlation coefficients determined. These authors conclude that acceptable positive correlations were observed for enterococci and E. coli in fresh waters and only for enterococci in marine and estuarine waters.

There are several reasons why these results may not be directly applicable to developing criteria for primary contact recreation at swimming beaches in Caribbean waters: (1) The studies of Cabelli and Dufour, were conducted in the temperate and subtropical areas of the Unites States, and the waters of the Caribbean are in the tropics and consequently warmer. (2) Methods for the quantification of other indicator organisms and for coprostanol, a fecal specific sterol, are now available and have not been evaluated in such prospective epidemiological studies of swimming related illnesses. (3) The nature of the swimming related illnesses occurring in the Caribbean areas are not known and the survival rates of the responsible etiological agents may not parallel those of the enterococci as do those of the organisms suspected of causing the swimming-related gastrointestinal illnesses observed in the studies conducted in the United States.

Care will have to be taken in selecting the location for these studies. The swimmers at many of the bathing beaches in the Caribbean are tourists from abroad and following the occurrence of illness in such a population for 10 days after swimming at a beach will be difficult. Also, such vacationers will most probably swim every day; thus if an individual does become ill it will be difficult to determine the day upon which he contracted the illness. Also, tourists may contract illnesses of a similar nature to those associated with swimming in contamined waters through other routes of exposure in their vacation environment to which they are not accustomed, thus introducing another confounding factor. Thus if such studies are to be conducted beaches frequented by the local population will be most promising for use in these studies.

References:

Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. U.S. Environmental Protection Agency, EPA-600/1-80-031. Cincinnati, OH.

Dufour, A.P. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. Environmental Protection Agency, EPA-600/1-84-004. Cincinnati, OH.

GROUP III: WATER QUALITY CRITERIA FOR PROTECTED AREAS AND WILDLIFE REFUGE

1. Introduction

Due to the limited available data on the natural resources found throughout the Caribbean Region there is often intense competition between the use of natural resources and the recognized need for their conservation. This conflict often results in the latter not being seriously considered as necessary for a country's sustainable development.

This difficulty of comparing the long term benifits of natural area protection with short term economic benefits has been possibly the greatest obstacle in the development of a system of protected areas for the terrestrial and marine environments.

There are several ecological benefits to be derived from the establishment of conservation and protected areas. Of greatest importance would be the following:

a. To enhance and diversify local and foreign tourism through the provision of new amenities to stimulate interest in outdoor activities.

b. Provide refuge areas for endangered and rare wildlife.

c. Provide protection of critical habitats for animals and plants.

d. Provision of areas for research in undisturbed conditions.

e. Preservation of representative areas of typical natural ecosystems.

The loss of unique and high quality aquatic ecosystem is a recognized problem in the Wider Caribbean region. The work group believes that there are both impacted and relatively non-impacted areas deserving of protection, maintenance, and restoration. Additionally, the work group noted very few actual numeric criteria in use which are unique to "protected areas".

The work group also noted that in countries where a system of standards consisted of classification of water and narrative/numeric criteria, the classification of the water body often provided the primary means of protection the existing quality of the water and it's ecosystem.

2. Review of Available WQC and Standards:

Except under natural pristine condition, the water quality of any given area can not be considered in absolute terms because it will vary according to the use and/or activity for which it has been designated. In areas where anthropogenic influences arise, this

present condition would have to be accepted as the "natural state", and unless similar unstressed locations exist for comparison, former conditions will have to be utilized as reference points. In most cases gradual and long term deterioration of the water quality in these stressed areas is proportional to the modifications that have taken place as the country's development has progressed.

The work group reviewed the available water quality criteria and standards as well as approaches in use to define and recognize areas to be placed in a "Protected Area/Wildlife Refuge".

The International Union for the Conservation of Nature and Natural resources (IUCN) has produced an internationally recongnized and accepted classification system which has been utilized by several of the Caribbean states and territories in the establishment of these areas (UNEP-(OCA)/CAR-WB.1/3 1988).

Protected areas have been classified into the following categories (IUCN, 1983).

1. Scientific reserves/nature reserves
2. National parks/marine areas
3. Nature Conservation Reserves/Wildlife Sanctuary
4. Protected landscape/seascape
5. Biosphere Reserves

A definiton for each of these internationally recognized classifications is given in Table 1.

Although there are a large number of parameters for which criteria have been established to provide protection of various life forms and water uses, the work group selected a limited number of parameters to examine for applicability to the region. These are shown in Table 2. It is immediately obvious that a recurring theme for the protection of unique and important aquatic systems is "no alternation". Due to the unique nature of the systems to receive the benefit of inclusion in a protected area scheme the work group believes that the best approach to take is to establish baseline data and make provisions through existing law to prevent alternation of the water quality within protected areas.

In general, the work group noted that the specific threats to area deserving "protected area status" are considerably different between the Caribbean mainland territories (e.g. Mexico, Colombia, Venezuela) and the island states of the Caribbean (e.g. Trinidad and Tobago, Barbados, St. Lucia).

The major objective behind establishing protected areas and wildlife refuges is to ensure that ecosystems selected reflect unique and/or representative areas of national or internationally significant geographic, geological and biological features of phenomenon. Additionally, the areas selected should be of special significance to the country or island state, maintain natural ecological integrity and thus provide an educational outlet which enhances man's understanding and appreciation of the natural environment without damaging it.

Based upon earlier work (UNEP-(OCA)/CAR.WB.1.3) the general types of systems deserving of protection are as follows:

1. Coral reef systems
2. Coastal lagoons/estuaries
3. Mangrove/wetlands
4. Submerged Aquatic Vegetation (SAV)
5. Wildlife refuges
6. Endangered species areas (e.g. nesting beaches for turtles)

Protected areas can be selected in several ways according to the particular legislation of the country:

1. political
2. economic importance, e.g. tourism, fishing
3. ecological, e.g., important specie, diversity

All of these factors must be considered and balanced if there is to be success in setting aside these important natural resorces.

The working group acknowledges the sovereignty of each nation to establish its law as noted in the Cartagena Convention.

TABLE 1

Definition of Protected Areas as Defined by IUCN

1. Scientific Reserves/Natural Reserves

   Representing natural areas containing outstanding ecosystems, geological features or species of national or international importance.

2. National Parks

   Relatively large areas not materially affected by human exploitation and occupation, containing special wildlife habitats and geomorphological sites of special scientific educational and recreational interest or are landscapes of beauty. Explotation is limited to pre-existing uses which area not detrimental to the protection of the park. Public access for inspirational, educational, cultural or recreational purposes.

3. National Conservation Reserve/Wildlife Sanctuary

   Areas managed for the stability or survival of unique or important species of animals or plants and their habitats. Habitats may be modified in the interest of target species.

4. Protected Landscape or Seascape

   Nationally significant natural landscapes characteristic of the harmonious interaction of man and which provide opportunities such as tourism within the normal lifestyle and economy.

5. Biosphere reserves

   Areas large enough to function as conservation units and accomodate different activities without conflict as approved by Man and Biosphere International Coordinating Council. Four zones will be included:

   natural or core zones
   buffer zones
   restorative zone and
   stable cultural zone

Table #2: Proposed and Existing Water Quality Criteria for Coastal Protected Areas and Wildlife Refuges - Tropical Waters.

Parameter	Water Quality Criteria											
	Colombia	Mexico	Cuba	Puerto Rico	Jamaica	Barbados	US Virgin Islands	Florida	Hawaii	Guam	US/EPA	EEC
pH	-	±0.2 of existing natural cond.	-	No alteration of Existing Natural Conditions except by Natural Causes		8.0-8.5	No alteration of Existing Natural Conditions except by Natural Causes	6.0-8.5	No alteration of Existing Natural Conditions except by Natural Causes	6.5-9.0	No alteration of Existing Natural Conditions except by Natural Causes (Tier - 3)	6-9
Temperature	-	±1.5°C of E.N.C	±2.5°C of E.N.C.			±1.0°C		No alteration of ENC		±1.0°C		-
Dissolved Oxygen	-	> 5.0 ppm	> 3.0 ppm			>5.0ppm		>5.0ppm		No alteration of ENC		±20% of ENC
Salinity	-	-	-			-		No alteration of ENC		No alteration of ENC		-
Nitrogen	0.04µmol/L (NO_3-N) 0.002µmol/L (NO_2-N)	No change which will result in Eutrophication	- -			0.7µmol/L (NO_3)		No alteration of ENC		0.10µmol/L (NO_3-N)		
Phosphorus	-		-			0.06µmol/L (PO_4)		0.1µmol/L		0.025µmol/L (PO_4-P)		
BOD	-	-	20.0-100 ppm			-		-		Free from alteration of existing Natural Conditions		-
COD	-	-	30.0-200 ppm									-
Clarity Turbidity	-	-	-			-5% of ENC		No alteration of ENC				No alteration of ENC
Suspended Solids	-	-	-			-		No alteration of ENC				-
Fecal Coliform	200/100 mls	-	200/100 mls			400/100mls		200/100mls				100/100ml

Note: 1) ENC - Existing Natural Conditions

3. Proposed Interim Water Quality Criteria, Rationable and Methodology

The working group recognized that in instances where there is an absence of established water quality criteria protected areas and coastal wildlife refuges, it would be prudent to assess existing baseline levels of potentially harmful substances, together with the physical parameters which characterize the water masses in these environments. For the targeted environments it is suggested that the distribution of the following minimum parameters be assessed:

pH, total suspended non-volatile solids, turbidity, dissolved oxygen, total nitrogen, total phosphorus, nutrients, salinity, temperature, biochemical oxygen demand, chemical oxygen demand, petroleum hydrocarbon residues, faecal bacteria, transparency, alkalinity, heavy metal, color and total Coliforms. A suggested list of parameters which should be monitored for specific ecosystems is given in Table 3.

Areas identified from baseline surveys as being most representative of pristine conditions will be designated as reference areas suitable for comparision with areas undergoing varying degrees of stress.

Irrespective of the existing state of the targeted environments, the data collected from statistically acceptable baseline surveys should be applied as interim water quality criteria for describing a quality of water necessary to sustain and protect wildlife refuges and protected areas.

Regulatory measures would be directed towards control of the use of these areas, for example, restricting further expansion and/or development of infrastructural facilities in the targeted environments. In cases where the protected area or wildlife refuge is deemed to be under stress, regulatory measures could be directed towards the reduction of the sources of this stress, eventually achieving ambient water quality levels consistent with low-stress or pristine conditions. For areas that are impacted by land-based sources of contamination, efforts should be made to control or eliminate these sources of contamination.

Once baseline data are collected to establish criteria a classification system similiar to the following should be applied depending on existing ambient water quality:

Table 3

Basic physical, chemical and biological parameters which need to be considered in establishing the water quality criteria for some coastal protected areas and wildlife refuges.

MANGROVES/WETLANDS

Salinity
Nearshore currents
Freshwater intrusion
Circulation patterns
Types of soil
pH
Nutrients
Temperature

CORAL REEFS

Sedimentation
Light
Salinity
Nutrients
Currents
Temperature
Bacteria

SEA GRASS BEDS (Submerged Aquatic Vegetation)

Types of soil
Depth
Transparency
Nutrients
Total Phosphorus
Total Nitrogen
Turbicity

Coastal Protected Waters (Unimpacted)

It is the objective of this class that these waters remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions. To the extent practicable, the natural unaltered character of such areas shall be maintained. The use to be protected in this class of waters are oceanographic research, the support and propagation of shellfish and other marine life, conservation of coral reefs and other ecosystems, compatible recreation, and aesthetic enjoyment. The classification of any water area as Coastal Protected Waters shall not preclude other uses of such waters compatible with these objectives and in conformance with the criteria applicable to them.

Coastal Protected Waters (Impacted)

These are coastal water whose present characteristics should not be altered in order to preserve their existing state. To extent practicable, the present impacted character of such areas shall be improved. The uses to be protected in this class of waters are oceanographic research, the support and propagation of shellfish and other marine life, conservation of coral reefs and natural areas, compatible recreation, and aesthetic enjoyment. The classification of any water area as Marine Protected Waters shall not preclude other uses of such waters compatible with these objectives and in conformance with the criteria applicable to these.

4. An Outline of the Programmes Required to Develop Appropriate Water Quality Criteria for the Region

Many of the developing countries of the region have declared areas for protection or as wildlife refuges. In many instances natural resources or existing conditions within these areas and very little is being done to acquire this information.

In small island states, there has been an increase in coastal development specifically to boost economic development. This has imposed varying degrees of stress on protected areas and wildlife refuges and in some instances, where development has taken place in protected areas, destruction of natural habitats has occurred.

The working group recognizes the existence of many shortcomings in the proper management of protected areas and wildlife refuges especially in small states. The need to harmonize coastal development for housing or tourism with the existence of protected areas and wildlife refuges is important for small island states because of their limited land areas.

With those factor in mind, the working group recommends the following programmes as guidelines in the implementation of effective management and which will lead to the development of water quality criteria in the future:

1. Perform inventories of the species of flora and fauna and of all related abiotic factors for diagnostic purpose to assess the status of said resources in the area of question.

2. Perform baseline surveys for ambient water quality in wetland areas, coastal lagoons, coral reefs, mangrove swamps and endangered species areas.

3. Based on (1) and (2) above, undertake toxicity testing programmes and bioassays aimed at assessing the effects of toxic substances and physical agents on sensitive species and other aspects of the ecosystem. Bioaccumulation studies should also be performed on those cases where such stress factors have been identified.

4. Execute rigorous environmental impact assessment (EIA) programmes prior to any development in the coastal area, which is expected to directly or indirectly affect protected areas or wildlife refuges, as well as careful evaluation of the EIA within the country to ensure its vitability as this is equally important.

5. Develop and demonstrate an environmental vulnerability index (EVI) to coastal zones in order to aid in the selection of the protected areas by each country.

Overview

For the mainland territories in the wider Caribbean protected areas and wildlife refuges in the coastal region should be set aside as natural reserves where preferably no exploitation of this areas is allowed. The quality of water affecting these areas should be maintained in their existing natural conditions and continously monitored. For impacted protected areas and wildlife refuges, measures should be taken to return the quality of water to a level comparable with near pristine conditions consistent with each type of ecosystem.

For island sites which have small land masses, increases in housing and tourism facilities should be strigently controlled and any wastes generated, discharged away from coastal water associated with protected areas or wildlife refuges. The maximum tolerable stress for these areas must be known before any development takes place.

Conclusion

It is absolutely necessary and of utmost importance that the programmes proposed by this workshop, for the development of adequate water quality criteria in the region, are recognized and implemented. This should be consistent with the development of projects I to V and VII, as proposed by the CEPPOL programme. This will respond to the need of effeciently using available funds and resources and to avoid the duplication of efforts.

Definitions

For the purpose of the working group, the following definitions were adopted as defined in the UNEP Cartagena Convention (1983):

1. "PROTECTED AREAS" means the areas established in order to conserve, maintain and restore (if necessary to a natural state) with a view to sustaining the natural resources of the Wider Caribbean Region, and encouraging ecologically sound and appropriate use, understanding and enjoyment of these areas, in accordance with the objectives and characteristics of each of them.

   In establishing such areas the following conditions should be included:

   (a) representative types of coastal and marine ecosystems of adequate size to ensure their long-term viability and to maintain biological and genetic diversity;

   (b) habitats and their associated ecosystems critical to survival and recovery of endangered, threatened or endemic species of flora and fauna;

   (c) productivity of ecosystem and natural resources that provide economic or social benefits and upon which the welfare of local habitants is dependent; and

   (d) areas of special biological, ecological, educational, scientific, historic, recreational, archeological, aesthetic or economic value including in particular, areas whose ecological and biological processes are essential to the functioning of the Wider Caribbean ecosystems.

2. "ENDANGERED SPECIES" are species or subspecies of fauna and flora, or their populations, that are in danger of extinction throughout all parts of their range and whose survival is unlikely if the factors jeopardizing them continue to operate;

3. "THREATENED SPECIES" are species or subspecies of fauna and flora, or their populations:

   (i) that are likely to become endangered within the forseeable future throughout all or part of their range if the factors causing numerical decline or habitat degradation continue to operate; or

   (ii) that are rare because they are usually localized within restricted geographical areas or habitats, or are thinly scattered over a more extensive range and which are potentially or actually subject to decline and possible endangerment or extinction.

4. "PROTECTED SPECIES" are species or subspecies of fauna and flora, or their populations, whose distribution is restricted to a limited geographical area.

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GROUP IV: WATER QUALITY CRITERIA FOR HARBOURS AND INDUSTRIAL AREAS

1. Introduction

The waters comprised by this classification include coastal areas and/or estuarine waters intended for harbors, ports and industrial uses, where there may be indirect human contact with these waters and some species can be maintained. It is the objective of this classification to allow the development of the industrial and transportation activities while also sustaining the maintenance of some species and indirect contact. In those water bodies where the established water quality criteria are not met, efforts shall be made to improve and protect the quality of the water in order to attain the designated use. A lower water quality may be allowed only when it is necessary to prevent a significant economic and/or social impact to the country or the region. Compliance plans should be developed to attain the water quality criteria established on the short-term and long-term basis.

2. Review of Available Water Quality Criteria

The report prepared by Mr. Carlos Fonseca entitled "Environmental Quality Criteria of Coastal Zones in the Wider Caribbean Region", as background document for this workshop was reviewed by this working group. The existing criteria of Puerto Rico, U.S.A., Colombia, Venezuela, Cuba and Mexico were compiled into a list of parameters common to the Region.

3. Proposed Interim WQC for the Region

Since in the different countries of the region there are areas subject to the development of port activities and discharge of industrial effluents, it is necessary to establish preliminary criteria, which permit compliance with the objective of this classification according to their designated uses. However, the restauration of these bodies of water is required for the indirect human contact to be established through the following criteria which can be adopted by the countries on a short-term and long-term basis.

1. Short-Term

Parameter	Proposed Criteria
Numbers in brackets indicate countries for which criteria was considered.	
1) Faecal Coliforms [4]	<2,000 MPN/100ML
2) Total Coliforms [4]	<10,000 MPN/100ML

3)	pH [4, 5]	6.0 to 9.0
4)	Temperature [1, 3, 4]	±2 to 3°C of ambient for the water body
5)	Salinity	To be developed
6)	Floating Materials	None allowed
7)	Oil and grease Guidelines	Follow Marpol Annex 73/78
8)	Foaming Agents	None allowed (none visible)
9)	Color	Color should not be changed to the extent that it affects marine flora and fauna
10)	Dissolved Oxygen	4 ppm or more

2. Long-Term

1) BOD

2) Total Suspended Solids

3) COD

4) Total Kjeldahl Nitrogen

5) NH3

6) Total Residual Chlorine

7) Phenols

8) Surfactants

No acutely lethal conditions shall be permitted outside of defined mixing zones. Mixing zones shall be limited to the extent practicable; and shall not be used as a substitute for that treatment.

3. Recommendations

a) Pesticides and Herbicides Contamination - Recommend preventive measures should be developed based on an inventory of existing use and consumption.

b) Metals - Recommend a survey of sources of metal contamination among Caribbean Nations and develop pollution prevention measures.

c) Organotins - Recommend research on effects to flora and fauna of the Caribbean with future action.

Numbers in brackets indicate the following countries for which criteria was taken into consideration:

1) Colombia
2) Mexico
3) USA
4) Cuba
5) Puerto Rico
6) Venezuela

4. Recommended Methodology

Phase I

1. Inventory of the land based sources of pollution

2. Characterization of the receiving water bodies

   a. Hydrographic, meteorological, geological and bathymetric topographic characteristics of the coastal areas;

   b. Location and type of the discharge (point or non-point sources) and its relationship to other areas (such as amenity, spawning, nursery, and fishing areas, or shellfish grounds) and other discharges;

   c. Initial dilution achieved at the point of discharge into the receiving marine environment;

   d. Dispersion characteristics such as the effect of currents, tides and wind on horizontal transport and vertical mixing;

   e. Receiving-water characteristics with respect to physical, chemical, biological and ecological conditions in the discharge area; and

   f. Capacity of the receiving marine environment to assimilate waste discharges without undesirable effects.

3. Use of available water quality modelling to identify the degradation of the water quality in the receiving body. Data from the model could be used to screen possible problems for those regions under similar circumstances which lack the resources to generate it.

A comprehensive impact analysis related to the discharge of a pollutant into a marine environment should be site-specific and encompass the following factors:

- Characteristics and composition of the pollutants;

- Characteristics of the pollutants with respect to their harmfulness;

- Characteristics of the discharge site and receiving marine environment; and

- Potential impairment of marine ecosystems and the effect on sustainable development.

Phase II

Development of the required plans to develop short and long range solution to achieve the established water quality criteria, and to revise and adjust accordingly.

5. Outline of the Programme Required to Develop Appropriate Water Quality Criteria for the Region

Previous knowledge of the area under study is most necessary in order to formulate a coastal water quality monitoring program, which includes:

a. Meteorological characteristics: evaporation, precipitation, winds and temperature

b. Designated uses

c. Main point and non-point sources of marine pollution including its volume, pollutant concentration, discharge frequency

d. Distribution and types of flora and fauna

e. Distribution of liquid pollutants in its dissolved, colloidal or particulate forms

f. Accumulation and release of the pollutants on, or from, marine sediments

g. Accumulation and release of the pollutants on, or from, aquatic biota

Monitoring Program

The definition of the proposed water quality program comprises the following stages:

a. Define the monitoring program objectives

b. Define geographic limits and time duration

c. Define the mathematical model to be used

d. Select the water quality parameters to be determined

e. Define location and monitoring frequency

f. Analytical methodology to be used

g. Cost of analyses

h. Processing of the generated information

Objectives of the Program

- Determine the baseline of the coastal water quality

- Establish the actual and future relations between present and future water quality on the basis of different contaminated loads.

- Identified unknown sources of contaminants

- To confirm if designated uses of these harbors and industrial waters agreed with the established quality

- Monitoring of the water quality and proposed preventive and corrective measures as well as to established contingency plans for accidental spills

Geographic Limits and Duration

It is necessary to defined harbor, ports and industrial areas included in the program and represented in the geographic limits and the main land sources of marine pollution on the maps. Also is necessary to defined the execution time of the program.

Mathematical Modelling

To select the mathematical model that represented the best proposed objective of the program.

Parameters Selection

The parameters will be selected on the basis of:

- An inventory of the land based sources of marine pollution, having in mind the pollution history in the coastal area under evaluation.

Sampling Location and Frequency

The principal factors which control the selection of the sites and the sampling frequency are:

- Hydrodynamic properties of the water bodies discharging in the coast of interest.

- Coastal dynamics (tides, currents, waves)

- Climatologic conditions (temperature, evaporation, precipitation, velocity and wind direction).

- Geographic location of point and nonpoint sources.

It is important to take into account the heterogeneous distribution of the quality of the coastal waters due to their thermal stratification.

Prior to the exact location of the sampling stations, it is recommended to conduct aerial recoinnassance of the coasts included in the program and to collect samples from various locations to determine conductivity, temperature and dissolved oxygen.

The frequency will be in accordance with the seasonal changes experienced in the coastal areas under study.

Analytical Methodology to be used

The selection of the analytical methodology will take into consideration the following aspects:

- Total quantity of analyses,
- Frequency and geographic extension of measures,
- Availabilty of time for implementation,
- Sensibility and detection limits,
- Selection and interferences, and
- Restrictions on precision and accuracy.

The evaluation of the total number and frequency of the analyses, will permit to determine the program of action required either manually or by use of instruments.

Similarly, the requirements of the detection limits, selection, precision will assist the analyst to decide what methods of analyses

Cost of the Analyses

The cost-benefit analysis of the proposed program is an optimal process to determine the minimum cost to acquire the required information. Due to the variability in the cost of equipment, reagents, labor, etc. it is difficult to provide recommendations in this aspect. Although the analyst will evaluate each of the steps included in the program in terms of cash, and will decide if it is necessary to modify them, whether to increase or decrease the number of sampling sites, frequency or parameter to be determined.

Processing the Generated Information

In this point the following should be considered:

- Expression of the results. It is recommended to adopt terminology and units of expression, which permit uniformalization of the nomenclature, and compare the results achieved by different programs of measures to be taken.

- Graphical Representation. This permits comparison of results of analyses or emphasize differences and similarities.

ANNEX V

REPORT OF THE WORKING GROUPS - SESSION II

GROUP I: TECHNOLOGY BASED EFFLUENT GUIDELINES AND STANDARDS FOR DOMESTIC SEWAGE DISCHARGES

1. Introduction

Technology based effluent guidelines for domestic wastewaters are values of relevant effluent quality parameters or percentage of removal of that parameter, that can be achieved from a specified and well designed, maintained and operated sewage treatment facility.

The work group defines "GUIDELINES" as:
recommended minimum or maximum values of selected parameters, which could be considered as current and future targets.

The work group defines "STANDARDS" as:
Minimum or maximum values as set by law or regulation and to be enforced by local authorities.

These standards and guidelines are point source ("end of the pipe") parameter values and by it's nature relatively easy to sample, analyse and interpret. They thus provide a quick tool for pollution control.

DOMESTIC WASTEWATERS are defined as wastewaters from:

1. toilet flushing (black water),
2. showers, wash basins, kitchen and laundry (grey water)
3. institutions like schools, hospitals, prisons, governmental offices, etc.
4. commercial sites like hotels, restaurants, offices, laundromats, etc.
5. cottage or small domestic industries, which can be very significant in Latin American Countries (Colombia), car workshops and battery refilling, cheese and yogurt manufacturing, slaughtering, etc.

"TECHNOLOGY BASED" means that these guidelines of relevant parameters are directly related to a certain technology of domestic wastewater treatment as applied in the region.

The selection of the parameters to be included in the standards and guidelines are dependent on the different types of domestic wastewaters and treatment facilities.

The work group wants to stress that more priority must be given to water saving and re-use of the wastewaters and effluents, i.e. irrigation, toilet flushing, etc. This will significantly reduce the amount of wastewaters disposed in the marine environment and also reduce the capital investment in sewage collection systems and treatment facilities.

The selection of technology and its appropriateness goes beyond the scope of this workshop. However, it is recognised that technologies should be appropriate for the region.

Appropriate technology is defined as:

Affordable;	ecomically
Acceptable;	socially and environmentally,
Available;	materials, spare parts, required skills, trainable manpower, etc.

It should be realised that these standards and guidelines are different in their development than those developed based on water quality criteria of the receiving environment; it should also be realised that these standards and guidelines approach will not stand by themselves but should be considered together with the tolerable pollution loads and water quality criteria of the receiving environment (as discussed and reported in Session I).

In specific areas where the technology based effluent guidelines are insufficient to protect water quality, then more stringent effluent standards are required.

2. Review of Technologies for Treatment of Domestic Sewage in the Caribbean Region

General:

Most individual households with piped water supply use onsite disposal facilities, like septic tanks connected to soakaways or drain fields. In Panama also trickling filters are used to treat effluents from septic tanks. In Trinidad aquaprivies are used and in Barbados suckwells (direct discharge into groundwaters) are commonly practiced.
Direct discharge of raw sewage into streams and coastal waters of raw sewage is a common practice too.

An increasing number of larger housing developments, commercial sites, hotels, and office complexes are connected to sewage treatment plants (STP's), that are privately owned and operated. Also some townships and municipalities are connected to STP's.
The different STP systems as used in the region are listed below.

Cayman Islands:

The only 4 sewage treatment systems are stabilisation ponds, operated by one full time employed operator. The facilities are in operation since early 1988 and no constraints and complaints are reported.

Colombia:

Mainly wastewater stabilisation ponds (anaerobic, facul- tative and aerobic). Two new system are being tested in pilot projects: Upflow Anaerobic Sludge Blanket (UASB) and the Piston Flow Anaerobic Reactor (PFAR). Both appear to have good results. Also promissing results are reported from the septic

tank-small bore sewer systems, expressed in cost effciency and BOD removal. Pilot hydroponic wastewater systems are also being developed. However, the majority of urban settlements are not connected to STP's.

Cuba:

Mainly wastewater stabilisation ponds as well as anaerobic and aerated ponds. Other systems include activated sludge, anaerobic digestors and primary sedimentation.

Eastern Caribbean (Anglophone):

Activated Sludge plants of the extended aeration type, of which some are Sequential Batch Reactors (SBR's) predominate. Also a few facultative pond and Rotary Biological Contactor (RBC) systems.

Eastern Caribbean (Francophone)

Aerated lagoons are most commonly used and for a few municialities activated sludge plants.

Honduras:

Primary sedimentation in Imhoff Tanks, wastewater stabilisation ponds, activated sludge with extended aeration and discharge through drainfields

Jamaica:

Mainly activated sludge plants (60%). Lagoon systems (18%), oxidation ditches (14%) as well as a few trickling filters, primary tratment plants, one sand filter and RBC.

Panama:

Primary sedimentation (7%), secondary treatment systems (5%), also stabilisation ponds and 40% of the wastewater is discharged untreated into the sea.

Puerto Rico:

Primary sedimentation, activated sludge plants, trickling filters, RBC's.

Venezuela:

Mainly wastewater stabilisation ponds and anaerobic ponds as well as activated sludge plants, RBC's, trickling filters, anaerobic digestors.

Constraints:

The general constraints as identified by the work group are:

1. Inadequate Operation and Maintenance (O&M), because of lack of trained personnel and operators, lack of financial resources and lack of spare parts and equipment.

2. Activated sludge plants are expensive to operate, due to high energy consumption and costs (Puerto Rico, Barbados).

3. Some plants have odour problems (mainly trickling filters and RBC's and some activated sludge plants)

4. Inadequate sludge removal, plants are generally small in size (hotels, housing developments) only a few large municipal plants, lack of monitoring equipment, lack of committment and legislation to enforce proper O&M.

5. Lack of institutional infrastructure for adeqaute monitoring, operational assistance and enforcment of recommended improvements.

6. Many plants are hydraulically and organically overloaded because of increase of population and wastewater discharges into the system.

7. International emphasis has been placed on potable water supply, while investments in wastewater management have been neglected. Excessive water use has also contributed to the increasing the amount of wastewater generated.

3. Review of the Available and Applied Effluent Guidelines and Standards in the Caribbean Region

	BOD mg/L	TSS mg/L	pH	F-Coli <- #/100mL	T-Coli ->	Res.Chl mg/L	Temp °C
Antigua and Barbuda	-	-	-	-	-	-	-
Bahamas[1]	<30	<30	6-9	+>85% removal of BOD and TSS			
Barbados	<25	<25	-	-	-	-	-
Cayman Isl.	< 30	< 30	-	-	-	-	-
Colombia[2]	>30%r	>30%r	6-9	-	-	-	-
Colombia[3]	>80%r	>80%r	6-9	-	-	-	-
Cuba[4]	<50	<50	6½-8½	<200	<2000	-	-
Guadeloupe[5]	<40	<30	-	-	-	-	-
Guatamala							
Honduras	<30	<30	6-9	+>85% removal of BOD and TSS			
Jamaica	<20	<30	-	<200	-	<1.5	-
Mexico							
Panama	>80%r	>80%r	-	-	-	-	-
Puerto Rico	<30	<30	6-9	+>85% removal of BOD and TSS			
Trinidad[6] and Tobago	<25	<30	6-9	<200	-	-	-
Trinidad[7] and Tobago	<125	<175	6-9	<400	-	-	-
Venezuela	<40	<50	6-9	<200	<1000	<0.5	-
St. Lucia	< 25	< 30	-	-	-	-	-

[1]EPA standards have been adopted in the Bahamas, Honduras and Puerto Rico.

[2]Existing treatment plants expressed in % removal of influent.

[3]New treatment plants expressed as % removal of influent.

[4]Guideline-use water quality base approach.

[5]Effluents from aerated ponds.

[6]For discharge into sea inshore and environmentally sensitive areas.

[7]For discharge into offshore and environmentally non-sensitive areas.

Barbados: The guidelines are enforced by the Environmental Enginering Division (Min. of Health), which monitors the operation of STP's at hotels.

Colombia: There are specific water quality criteria and wastewater effluent guidelines and limits (Decree 1594/84). The Ministry of Health, INDERENA (National Institute for the Protection of the Environment), Regional Corporations and, in the case of coastal areas, DIMAR (Maritime Directorate) are in charge of this enforcement. Industries are in general complying with norms, but municipalities are quite behind schedule.

Cuba: The Cuban guidelines are adequate, but the BOD guideline is in some cases difficult to achieve. The guidelines and legislation are enforced, but there are institutional and physical limitations to monitor all plants.

Guadeloupe: The guidelines are not enforced, but there is control of performance of the percolation of the effluents from septic tanks. In order to achieve an efficient enforcement a structural reform of sanitary department is required.

Honduras: The adopted EPA guidelines are appropriate in most of the cases, but they are considered together with capital and operational costs.
There is inadequate legislation to enforce guidelines.

Jamaica: The operational values are set by the Environmental Control Division (Min of Health) and are used in advising different entities of the desired discharge limits. There is no specific legislation or gazetting of these criteria and they are not strictly enforced.

Puerto Rico: The guidelines are suitable for the country and are used as design criteria. The Environmental Quality Board (EQB) has the responsibility to enforce the standards. A monitoring programme exists.

The major constraint in enforcement are the limited human resources for the surveillance and the inadequate operation and maintenance of the plants.

Venezuela: The guidelines are suitable from a social, environmental and economic point of view, 50-60% of the plants comply with the guidelines. There is a lack of human and economic resources for surveillance.

4. Proposed Guidelines

The work group recommends that the effluents of any domestic wastewater treatment plant should be free of oils, grease and any floating matter. Furthermore the concentration of the parameters shown in the table below and related to the indicated treatment system, should not be exceeded:

	BOD ppm	TSS ppm	pH	F-COLI mpn/100 ml	TEMP °C
Effluents of:					
Facultative Ponds	30-60	50-60	6-9	<200	<40
Aerobic Ponds	25-50	30-50	6-9	<200	<40
Activated Sludge	20-30	30-40	6-9	<200	<40
Seq. Batch React.	30-50	50-70	6-9		<40
Anaerobic Systems	30-50	40-60	5-9		<40
Trickling Filters	30-60	50-60	6-9		<40
Rot. Bio Cont.	40-60	50-60	6-9		<40
Proposed	30-60	40-70	6-9	<1000	<40

These proposed guidelines are more conservative than the treatment efficiencies listed above, because the workgroup realised that the proposed guidelines are more realistic for the region in terms of economic, social and human resources in the region.

The technologies indicated are the ones currently applied in the Caribbean and do not endorse or support the appropriateness of these systems under the specific situation, location and condition. As listed, the treatment systems are options and should be evaluated and compared against other on the basis of economic, social and environmental acceptability, required human resources, institutional capabilities, etc.

The Best Achievable Levels were determined using the EPA technology fact sheet for each selected treatment systems and assume normal domestic wastewater characteristics of influent, proper design, operation and maintenance of the treatment system.

It is debateable if guidelines for F-Coliforms should be included, because secondary treament plants have generally high F-Coli counts, (with the exception of wastewater pond systems). Although feacal coliform is not an adequate indicator of potential human health risk it is seen as sufficiently important that it is included.

Faecal coliform counts of <200 /100ml can only be achieved after effective disinfection using chlorine gas, tablets, UV or ozone. In the Caribbean disinfection is generally less effectively performed and a maximum count of 1000 /100 ml is proposed.
Constraints for the implementation of these guidelines as standards in the Caribbean region are:

1. Rapid urbanisation, population growth and increasing financial investment in the water supply sector, without adequate wastewater collection and treatment, have resulted in an increasing problem of wastewater management. The investments in the sanitation sector are lagging behind, and increasing amounts of wastewater are discharged untreated or partially treated into the environment.

2. Only a limited volume of wastewater is collected and treated, furthermore a significant number of the present sewage treatment plants are inadequately maintenained and operated and do not meet the above recommended levels. Hence a large volume of raw and partially treated wastewater is discharged into the environment.

3. In the process of selecting the technology for wastewater treatment, not enough consideration is given to the local conditions and situation. As a result in a significant amount of cases, the selected technology is not appropriate as defined on page 1. Financial resources, operational skills and human resources are often not available for proper operation and maintenance.

4. A very low priority is given to wastewater management sector on all social and governmental levels.

5. There is not enough awareness and consciousness about the importance of wastewater management and to share responsibility and costs for wastewater management.
Community based solutions have not been sufficiently considered.

5. Recommendations:

The workgroup unanimously recommends the following:

For immediate action:

1. Identify and quantify all point sources of untreated and treated sewage disposal.

2. Encouragement of national legislation and enforcement to eliminate all discharges of untreated wastewater, by requiring interim treatment or adequate disposal.

3. Conduct follow-up workshop with sub-regional working groups to stress sub-regional approaches to develop a comprehensive implementation programme:

   a. training courses in plant operation and maintenance; i.e. process monitoring and control
   b. compliance monitoring and surveillance;
   c. permit and enforcement systems;

4. Wastewater disposal should be reduced by stimulating wastewater re-use of effluents for irrigation (above as well as under ground), toilet flushing, and encourage beneficial uses of wastewaters and sludges s.a. composting, fertilisers, aqua-culture, hydro-ponics, etc.

5. Disposal of sludges at landfills and in coastal areas should be discouraged.

6. The environmental impacts of domestic wastewater, effluents and sludge disposal should be reduced by disposal in environmentally less vulnerable areas. Care should be taken of the possible levels of hazardous substances in wastewaters and sludges to avoid surface and groundwater pollution.

7. The human health impact of domestic wastewater and effluents disposal should be reduced by disposal of effluents in areas where limited human contact can be expected.

8. Public education and participation programmes should be initiated to increase community awareness on the importance of wastewater management and the necessity to contribute to the costs involved.

Medium Term Action:

9. Wastewater generation should be reduced by stimulating water saving and efficient use practices such as dry excreta disposal facilities, use of low volume flush toilets, etc

10. The environmental impacts of domestic wastewater, effluents and sludge disposal should be minimized. In the particular case of wastewater and effluents the levels of BOD, TSS should be reduced to about 30-60 and 40-70 ppm respectively, while the pH should be between 6 and 9 and the temperature below 40°C. With regard to BOD and TSS efforts should aim on reaching the lowest level, whenever attainable.

11. The human health impacts of domestic wastewater and effluents disposal should be minimised by reducing the levels of the indicator organism F-Coli to a maximum of MPN 1000/100mL.

12. Development of uniform protocol for sampling procedure and analytical methods in order to make results comparable.

5. Research Needs

13. Research should be stimulated to develop appropriate technologies of wastewater treatment, considering economical, social, cultural, climatological, environmental, health, educational and technical aspects. (need more specifications)

14. Curricula of research institutions (universities, regional institutes, etc.) should broaden the traditional concept of sanitary engineering to environmentally sound water and wastewater management, including efficient use and re-use of water.

15. Development of simpler, cheaper and scientifically sound sampling procedures and analytical methods should be encouraged.

GROUP II: SUGAR MILLS/REFINERIES, RUM DISTILLERIES AND FOOD PROCESSING

1. Introduction

The work group initially identified that the categories listed in the title were widely distributed throughout the Caribbean Region. The group realized that there was a need to clearly subdivide the areas to be worked on, and at the same time reflect the principal types of industries that were located within the region.

Effluent guidelines are very limited within the region (both in mainland territories and especially in island states) but with in the last decade there has been an increasing awareness as to the need to incorporate effluent guidelines on certain industries which are known to be major point sources of pollution.

Sugar mill and refining processes were compared between the Caribbean, Hawaii, Louisiana and Florida, and it was noted that since manual harvesting still exists widely throughout the islands of the region the types of effluent discharged from the factories were potentially less loaded with suspended solids and less stressful on the environment than in other developed countries where methods of mechanical harvesting were employed. However, organic loading is high.

In the food processing industry the methodologies employed in the Caribbean area appeared to have significant problems as related to the types of raw effluent that are produced. It was the concensus of the group that in much of the region, these untréated effluents were often discharged directly to the marine environment.

There is therefore an urgent need to establish effluent guidelines for the region but prior to this there has to be an assessment of the type of technologies that presently exist. These existing technologies may be considered inadequate from an environmental protection perspective. To this end the work group attempted to identify the technologies considered as the Best Practical (BPT) and Best Available (BAT) for the industry groups under consideration. The group then tried to determine what may be the most feasible options for future work towards establishing effluent guidelines for these industries given the economic and technological capability of the region's countries and territories.

2. Review of available effluent guidelines

From information gathered from the participants in all groups it was clear that there is limited information relating to the presence and enforcement of effluent guidelines throughout the region. This limited information may be a result of:

1) Ignorance of participants.

2) Non-utilization of guidelines even where they exist.

3) Non-Existence.

There is limited wastewater treatment technology in the Caribbean except for the larger and more sophisticated industrial sources. In these cases guidelines often established by the parent company, are followed by their representatives located within the Caribbean Region. Other industry types have to utilize parts of the treatment systems and relevant effluent guidelines to ensure some measure of acceptable discharge.

Effluent guidelines utilized by the EPA for the following types of industries were reviewed and are summarized in Table 1 in the following categories: Cane Sugar, Beverages (Rum, Soft drinks, Brewery), Red Meat and Poultry processing, Edible (vegetable) oil, Fruit and vegetable and Seafood processing.

From the review of the EPA guidelines it was noted that in all Best Practical Technologies, screening of effluents is a first basic step of treatment in addition to the other treatments identified. This is necessary to remove gross solids, trash, and other debris. In some industries, screening is followed by primary treatment (e.g., settling) of wasterwaters to reduce very high levels of suspended solids. These solids are either brought into the plant with the raw material to be processed (e.g., field dirt on sugar cane) or are removed from the raw material itself. Primary treatment also may be air flotation to remove oil and grease and other flotable material (e.g., residual oils from edible oil processing and refining, and animal fat from slaughtering and packing houses). Wastewaters from almost all of these industries contain levels of oxygen demanding organic matter (BOD) that are from a few times greater to many orders of magnitude greater than raw domestic sewage. Therefore, secondary biological treatment serves as the most important component of Best Practicable Technology (BPT). These biological treatment systems remove in excess of 90 to 97 percent of the raw BOD. Most treated effluents, with some exceptions, have BOD (five day) concentrations of less than 100 mg/l with suspended solids concentrations somewhat higher. For those industries where oil and grease are important (e.g., Red Meat and Poultry processing, Edible Oil processing), the combination of air flotation and biological treatment results in treated effluents with oil and grease concentrations of less than 25 mg/l.

In all cases, it is extremely important to also adopt a pollution prevention strategy as a first step to reduce the volume and pollutant loads of waste water generated. This has the critical benefits of 1) reducing the size and cost of waste water treatment system, 2) reducing the volume of fresh water needed for processing, 3) creating opportunities for recovery of saleable by-products, and thus 4) reducing the cost of production while conserving limited and valuable natural resources. Some examples of existing strategies that could be applied are:

1) Recycle barometric condenser cooling water in place of once-through cooling

2) Use counter-current wash water recycle system (eg. cane washing)

3) Use dry clean-up where possible; in other cases eliminated continously running hoses and replace with high pressure/low-volume systems

4) Segregate high-strength waste streams and pre-treated or recover as by-product (eg. blood from animal kill rooms can be processed and used as animal feed supplement or fertilizer)

5) Eliminated fluming of product within plants; replace with dry conveyance systems (eg. belts or vacuum)

6) Use entrainment control devices on evaporators and vacuum pans

7) Recover solubles from seafood bail water

8) Recover fin fish (and shellfish is possible) wastes (eg. heads, tail, viscera) as secondary protein and oils in solid reduction facilities

9) Recover oils and greases from flotation systems

10) Investigate use of anaerobic pre-treatment for very high strength waste for recovery of methane gas as boiler fuel

11) Investigate use of final treated effluents as source of irrigation water

12) Educate and train plants employees on the need for water conservation

3. Suitability and adaptability to the region

The working group agreed that the available effluent guidelines which were reviewed may not necessarily be suitable to the region but they may be adaptable. The EPA guidelines could provide a basis from which guidelines for the region could be generated after due considerations of existing technological, economic and political realities of the region.

4. Proposed interim effluent guidelines

Interim effluent guidelines should be based on a function of existing conditions. To this end there is a need for surveys to be carried out to determine what treatment technologies currently exist and can be implemented in the short term to progress towards what may be considered as the BPT. However individual industries or governments may wish to utilise US-EPA guidelines until local studies have been completed.

Table 1

Review of Available Effluent Guidelines: (US/EPA Requirement)

Effluent discharge for Industry Production	Best Practical Technology (BPT)	Best Available Technology (BAT)
Sugar	Biological Treatment	Recycling Condenser Water
Rum	Anaerobic digestion/Methane Recovery -No classification	
Soft Drinks	Secondary Treatment	* Advanced Water Treatment
Brewery	Biological treatment and flow equalization	Carbon Absorption and filtration
Meat Poultry	Dissolved air flotation and biological treatment	Ammonia stripping nitrification to remove TKN and NH_3
Edible Oil	Dissolved air flotation and biological treatment	Additional filtration
Fruit and Vegetable	Biological Treatment	Filtration
Seafood	Screening	Flotation
Tuna	Sceening + air flotation	Biological Treatment

* Advanced water treatment includes filtration, chemical treatment, total organic carbon (TOC) removal.

There are several conditions which should be used a basis on which to identify factors necessary to move towards the establishment of interim guidelines:

1- Studies need to be undertaken to identify the nature (e.g., flow, pollutant concentrations) of industrial discharge.

2- Develop water recycling systems for waste water reuse prior to discharge on the nearby body of water

3- Need to establish compliance schedules with industries in order to meet BPT effluent discharge limitations.

4- Develop black and grey lists of pollutants based on production types in accordance with the Montreal guidelines for the implementation under the London Convention and MARPOL 73/78 for the types of parameter measurements needed to be analysed on a regular basis.

5- A self monitoring programme should be undertaken by the industry. The government will verify compliance by conducting separate evaluation of reported data and inspections.

6- Key information on several aspects of the production process which may be directly related to wastewater effluent guidelines is essential before developing locally applicable guidelines. The industrial monitoring should include information related to:
   a) Water use
   b) Percentage of raw waste removed across treatment,i.e.

$$\frac{(\text{Influent} - \text{Effluent})}{(\quad \text{Influent} \quad)} \times 100$$

The range produced should be under 100 mg/l of BOD or in excess of 90% of wastewater.

5. Recommendations (Research, Legislation, etc.)

The work group proposes the following recommendation:

1- Undertake proposal listed in Section 2 immediately

2- For all existing industries there is a need to incorporate (where necessary) some form of effluent pre treatment prior to discharge to publicly owned treatment works. To this end a long term objective could be the introduction of screening and floatation technology as a requirement for BPT considerations. Regular monitoring needs to be undertaken to ensure there is no violation to any

guidelines identified. Pre-treatment of effluent at its source may also be more cost effective than treating combined wastes in publically owned treatment works (POTW).

3- Adopting and designing pollution prevention strategies as described in Section 2, prior to designing and constructing waste water treatments systems.

4- Effluent limitations are often based on concentrations or mass loading (where mass loading is the value of pollutant per raw material or finished product). Mass loading does not identify if the industry has found a way of diluting its concentration to meet its main loading limitation since mass loading is based on water use and the concentration that can be achieved at the end of the discharge pipe. Using the concept of mass loading may be more applicable to the Caribbean region.

5- New entities should operate under the BPT guidelines such as those in Table 1 after due consideration and acceptance by individual countries. The rationale for this is that as a new industry, the access to new technology is more readily available than for some industries that may already be in operation. These latter industries would need to meet these new requirements. To this end the guidelines would come into operation from the time legislation is established to enforce the guidelines. Thereafter all industries operating prior to the date the legislation was established would have to agree to fulfilling compliance schedules to reach the BAT guidelines set up.

6- Research has to be undertaken through out the region to determine what conditions presently exist, with a view to implementing some form of achievable guidelines which can be established in the long term.

7- Examination of the usefulness of BOD measurements in tropical conditions and consideration of alternatives.

8- Assessment of available technologies for their economic and technological suitability in the Caribbean.

9- National workshops/seminars involving government and industry participants should be held to disseminate information on standards and guidelines, increase awareness of the need for environmental protection and assess national readiness and interest in development of standards and guidelines.

GROUP III: PETROLEUM REFINERIES AND PETROCHEMICAL PLANTS/CHEMICAL AND PHARMACEUTICAL PLANTS

1. Introduction

1.1 The purpose of this document is to contribute to the process of developing effluent limitations for industrial facilities in the petroleum refinery, chemicals --including petrochemicals--, pharmaceuticals, and electric power generating industries. The document reviews the available effluent limitations control mechanisms in the Caribbean Nations; discusses the suitability and adaptability of technology-based effluent limitations as an end-of-pipe (discharge point) control for pollutant discharges from the above described industries; contains proposed interim effluent limitations; and makes recommendations with respect to future action to implement effluent discharge controls.

1.2 This document is a draft consisting of a compilation of ideas and data pertinent to the evaluation of incorporating technology-based effluent limitations. The idea of producing this document was to provide experts attending this workshop with a paper which begins the process of putting into place a complementary system of industrial wastewater discharge control which incorporates technology-based effluent limitations as mininum end-of-pipe controls with water quality criteria and standards being used to require more stringent control based on receiving water characteristics and designated use.

2. Review of the Available Effluent Guidelines and Standards

Table 1 details the countries that may or may not have effluent guidelines applicable to the petroleum refineries, petrochemical plants, chemical and pharmaceutical plants and power plants.*

The following was established:

2.1 Many effluent limitations applicable to various industries included a general list of pollutants;

2.2 The effluent guidelines of the countries mentioned in Table 1 are based on the following Regulations:

a) World Health Organization (WHO)

b) Environmental Protection Agency (EPA)

c) Individual regulations as in the case of:

- Colombia
- Cuba
- Guadeloupe
- Mexico
- Venezuela

* (Based on a consensus realized through the participants of the workshop.)

Table 1

Industry Effluent Limitations

Country	Industry			
	Chemical	Petroleum Refining	Pharm.	Power
Antigua & Barbuda	No	No	No	No
Bahamas	WHO/EPA	WHO/EPA	WHO/EPA	WHO/EPA
Barbados	No	US/EPA	No	±3°C Existing Natural Condition
Colombia (1)	Yes	Yes	Yes	Yes
Cuba (2)	Yes	Yes	Yes	Yes
Guadeloupe (France)	Yes	Yes	Yes	Yes
Guatemala	No	No	No	No
Jamaica	No	No	No	No
Mexico	Partial	Yes	No	Yes
Trinidad/Tobago	US/EPA	50 ppm/ 100 ppm Oil & Grease Only	US/EPA	US/EPA
Puerto Rico/ Virgin Islands (USA) (3)	Yes	Yes	Yes	Yes
Venezuela (4)	Yes	Yes	Yes	Yes
Cayman Islands	No	No	No	No

1 Applicable to general classes of pollutants (specific permits have more controlled pollutants based on characterization of industrial discharges)

2 Applicable to general classes of pollutants

3 Industry specific and pollutant specific

4 Applicable to general classes of pollutants

2.3 USA has pollutants limited for specific industries based on the characterization of their wastewaters and their treatability.

With respect to Colombia water users dischargers are required to apply for concessions of water use that must be registered within an established term. There is also a decree *that within its legal context contemplates and regulates the use of the waters and water discharges through the establishment of legal minimum guidelines that apply to any characterized discharge to a body of water.

Effluent guidelines are established taking into consideration the water quality criteria established to the designated uses of the water bodies. In the same manner the allowable concentrations of certain substances of sanitary interests are established.

The petrochemical and refinery industries are classified as users of the water resource.

When the users dischargers even though complying with the effluent guidelines have the effect of producing in the receiving water bodies higher concentrations than those allowed by water quality criteria to the designated use more stringent effluent are imposed.

The "INDERENA" ** also requests a characterization of the effluent following accepted applicable methodology of sampling and analysis within a determined time for and evaluation by "INDERENA".

On the basis of this information a discharge permit is issued either on a temporary or permanent basis depending on compliance with the effluent guidelines.

In the case of non compliance of the effluent with the established values a compliance plan within established terms will be issued taking into consideration if the facility is an existing facility or a new source.

* (Decree Number 1,594 issued on 1984.)

** (Instituto Nacional de los Recursos Naturales Renovables y del Medio Ambiente)

3. Suitability and Adaptability to the Region

The working group assessed the suitability and adaptability of available effluent guidelines and standards to the region. The following points were considered in the deliberations:

a. The island states in the region have one or few of each industrial category located in the coastal area. These areas are often subjected to conflicting uses.

b. Continental countries have more zonification flexibility than the islands of the region.

c. The affordability of technology is an issue. In some cases the economic achievement determinations as well as technology performances (due to the different climatic conditions) may be different.

Based on these points it was agreed that further information was needed to fully assess the suitability and/or adaptability of existing guidelines especially in the context of small island states which require conflicting uses of coastal areas.

4. Proposed Interim Effluent Guidelines for the Wider Caribbean Region

The working group noted the existence of effluent guidelines in some of the Caribbean territories. These guidelines were developed independently by each country and with their specific needs taken into consideration. In most cases the guidelines were industry specific and varied from one country to the other.

For countries having existing effluent guidelines no interim effluent guidelines are necessary. However, the following measures should be undertaken to ensure the proper administration of the effluent discharge limits:

a. Routing monitoring of the effluent at the "end-of-pipe" to ensure compliance with set guidelines

b. Enforcement of available legislation or enabling new legislation to force industries to comply with set effluent guidelines

c. Upgrading of effluent treatment facilities using a best practicable and/or best available technology approach

d. A review of existing effluent guidelines in the light of recent advances in effluent treatment technology

e. Establish regular routine monitoring programmes to ensure compliance with set guidelines.

Industries which have been established in coastal areas of many of the Caribbean territories and island states were done so without a proper assessment of their socio-economic and environmental impacts on that coastal area. Also, because many of these industries are old, the effluent treatment facilities on site may be outdated or non-existent.

It may be difficult to minimize the effects on the environment at this point in time through the implementation of cost effective methods of effluent treatment. The environment has adapted to the stress placed on it over the years and has probably achieved a balance. It is important however, that no further stress be added and measures taken to reduce the effluent load into the coastal environment.

5. Recommended Research for the Establishment of Effluent Guidelines and Legislation for the Wider Caribbean Region

The working group recommends that research be undertaken to develop effluent guidelines which will address the specific needs of the small island states in the Caribbean.

To establish effluent guidelines for the discharge of liquid wastes into the coastal environment it is important to have an understanding of the capacity of the receiving waters to assimilate and distribute the discharged effluent. The following criteria are necessary for this:

a. Watermass movement in the coastal environment,

b. Existing sediment load,

c. Coastal interactions between riverine discharges and saline waters, especially in terms of fresh and/or salt water lenses and thermoclines,

d. Meterological conditions,

e. Seasonal climatic variations,

f. Toxicity levels on potentially impacted flora and fauna.

Research is therefore needed on assessing, these criteria and thus establishing the capacity of any watermass for potential industrial use.

In the context of existing industrial facilities it is impossible to determine whether existing effluent discharge limits meet the carrying capacity of the receiving watermasses. However, for the establishment of new facilities (which would have access to all new technology) an environmental impact assessment, incorporating all the above criteria, should be performed. Also worthy of consideration is the undertaking of a socio-economic impact prior to the demarcation of an area for industrial use.

Another important consideration is the assessment of the biological and physio-chemical inventories of the coastal areas and thus their classification into areas which can tolerate industrial activity as well as determining the type of activity to be conducted in a specified area.

It is suggested that an assessment of both existing technology-based treatment facilities and legislation applicable to the enforcement of effluent guidelines, be conducted.

Also, it is suggested that a petroleum refining facility (common throughout the region) be chosen as a case study to develop effluent limitations which will be applicable to the Wider Caribbean Region.

Research is required on determining whether interim effluent guidelines will achieve the required water quality standards for an impacted area. Also research is needed on improving existing effluent treatment technology in the region, thus bringing effluent discharges in line with water quality criteria for the receiving water bodies.

GROUP IV: MINING AND METALURGICAL ACTIVITIES

1. Introduction

The work group discussed the known types of mining occuring in the region and their location. The following tabulation resulted from that discussion and consultation with the other work groups:

Type	Location
Gold	Dominican Republic, Mexico, Puerto Rico, Guyana, Colombia, Venezuela, Panama, Honduras
Silver	Guyana, Mexico, Honduras
Copper	Mexico, Puerto Rico, Cuba, Panama
Nickel	Cuba, Puerto Rico, Dominican Republic, Guatemala, Colombia, Cuba
Coal	Mexico, Colombia, Guyana
Zinc	Mexico
Cadmium	Mexico
Lead	Mexico
Bauxite	Jamaica, Guyana, Surinam, Venezuela
Iron	Venezuela, Mexico, Colombia
Phosphate	Florida, USA
Fluoride	Mexico
Manganese	Mexico
Kaolin	Guyana
Diatomite	Bahamas
Sand and Gravel	All
Crushed Stone/Dimension Stone	All

Additionally, it was concluded that the following metalurgical activities occur in the region:

Smelting and Refining

Since these multiple activities are clearly beyond the capability and time available to the workgroup, the list was reduced to those believed to be of general interest to several of the region's countries. The reduced list follows:

Important Mining Activities

1. Precious Metals
2. Nickel
3. Bauxite
4. Sand and Gravel

In addition, the work group considered that smelting and refining should be addressed.

In general terms, the extraction of minerals without proper environmental controls results in the release of large quantities of suspended solids, adversely impacts pH, and can elevate the concentration of the mineral being mined in the receiving waterbody to levels toxic to aquatic organisms. Other than sand and gravel, the majority of the listed activities occur inland away from the coastal waters. The pollutants from these mining activities are transported to coastal waters by way of rivers and streams.

2. Review of the Available Effluent Guidelines and Standards

The only effluent guidelines and standards available to the work group were those prepared by the US/EPA and published in the Code of Federal Regulations. A summary of those effluent guidelines and standards relevant to the topic assigned to the work group are as follows:

		BPT, mg/l	BAT, mg/l	NSPS, mg/l
1. Dimension Stone				
No effluent guidelines				
2. Crushed Stone (USA 40 CFR 436)		*	-	-
pH				
3. Construction Sand and Gravel				
(USA 40 CFR 436)		*	-	-
pH				
4. Industrial Sand (USA 40 CFR 436)		45	-	-
TSS	max/day	25	-	-
	ave/month	*	-	-
pH				
5. Phosphate Rock (USA 40 CFR 436)		60	-	60
TSS	max/day	30	-	30
	ave/month	*	-	*
pH				
6. Iron Ore (USA 40 CFR 440)		30	-	30
TSS	max/day	20	-	20
	ave/month	2	2	2
Fe (dissolved)	max/day	1	1	1
	ave/month	*	-	*
pH				

*pH range 6-9

			BPT, mg/l	BAT, mg/l	NSPS, mg/l
7.	Aluminum Ore (USA 40 CFR 440)				
	TSS	max/day	30	-	30
		ave/month	20	-	20
	Fe (Total)	max/day	1	1	1
		ave/month	0.500	0.500	0.500
	Al	max/day	2	2	2
		ave/month	1	1	1
	pH		*	-	*
8.	Mercury Ore (USA 40 CFR 440)				
	TSS	max/day	30	-	30
		ave/month	20	-	20
	Hg	max/day	0.002	0.002	0.002
		ave/month	0.001	0.001	0.001
	Ni	max/day	0.200	-	-
		ave/month	0.100	-	-
	pH		*	-	*
9.	Nickel Ore (USA 40 CFR 440)				
	TSS	max/day	30-50	-	-
		ave/month	20-30	-	-
	Cd	max/day	0.100	-	-
		ave/month	0.050	-	-
	Cu	max/day	0.300	-	-
		ave/month	0.150	-	-
	Zn	max/day	1.000	-	-
		ave/month	0.500	-	-
	Pb	max/day	0.600	-	-
		ave/month	0.300	-	-
	As	max/day	1.000	-	-
		ave/month	0.500	-	-
	pH		*	-	-
10.	Copper, Lead, Zinc Gold, and Molybdenum Ore (USA 40 CFR 440)				
	TSS	max/day	30-50	-	30
		ave/month	20-30	-	20
	Cu	max/day	0.300	0.300	0.300
		ave/month	0.150	0.150	0.150
	Zn	max/day	1.0-1.5	1.0-1.5	1.500
		ave/month	0.5-0.75	0.5- 0.75	0. 750
	Pb	max/day	0.600	0.600	0.600
		ave/month	0.300	0.300	0.300
	Hg	max/day	0.002	0.002	0.002
		ave/month	0.001	0.001	0.001
	pH		*	-	*
	Cd	max/day	0.100	0.100	0.100
		ave/month	0.050	0.050	0.050
	As	max/day	1.000	-	-
		ave/month	0.500	-	-

*pH range 6-9

3. Suitability and Adaptability to the Region

The workshop participants discussed the concept and application of effluent guidelines and standards to industrial activities in the Wider Caribbean. There are potential problems in implementing a regulatory scheme involving strict application of effluent guidelines and standards to industrial and mining activities in the region.

In some cases, the industry is either owned by the government or heavily subsidized in order to promote economic growth and provide jobs. In these cases, the possibility of a conflict between economic development and environmental protection may develop. Additionally, the region does not have a history of regulating industrial wastewater discharges utilizing a concept of applying a minimum technology.

Thus, the consensus of the work group is that effluent guidelines and standards are adaptable to the region as guidance for evaluating wastewater discharges from mining activities. New mining activities should be held more strictly to these guidelines because the opportunity to do so is easier. Existing mining activities can be evaluated using the effluent guidelines and standards in Section 4 in order to determine whether additional controls should be required or negotiated.

4. Proposed Interim Effluent Guidelines

The mining and subsequent elaboration of the ore may degrade the quality of the receiving waters. The following best management practices should be adopted to prevent of reduce the pollution potential at a mine or plant site:

a. Surface Water Diversion

The flow of the surface waters into the mine or plant site should be interrupted and diverted around and away from incursion into the mine or plant site.

b. Berm Construction

Berms, including any pond walls, dikes, dams and similar water retention structures, should be constructed in such a manner that is reasonably expected to reject the passage of water.

c. Pollutant Material Storage

Measures should be taken to assume that pollutant materials removed from the process water and wastewater streams will be retained in storage areas and not discharged or released to the receiving waters.

d. Water Supply

The amount of new water allowed to enter the mine or plant site for use in ore processing should be limited to the minimum amount required as make-up water for processing operations.

e. Maintenance of Water Control and Solid Retention Devices

All water control devices, such as a diversion structures and berms, and all solids retention structures, such as berms, dikes, ponds and dams, should be maintained to continue their effectiveness and to protect from unxpected and catastrophic failure.

The most widespread mining activity in the Caribbean Region is related with construction materials such as: (1) dimension stone, (2) crushed stone, (3) sand and gravel and (4) fill material. Interim effluent guidelines should be established to regulate these activities.

The water quality problems generated by the mining activities can be devided into two main groups. Those related to the extraction by dredging which can create turbidity problems in the bodies of water and those related to the washing operations at the quarry or pit. The dredging operations can be controlled by the application of water quality standards or criteria; however, the washing operations should be controlled by effluent limitations or zero discharge.

The effluent guidelines should take into considerations the following parameters and concentrations:

Pollutants	Max/day (mg/l)	Ave./month (mg/l

In order to comply with these parameters, sedimentation ponds could be constructed in series for the removal of the sediments and to recycle water.

The pH can be controlled by adding lime or acid to the ponds before discharging depending on the pH of the water.

The mining of bauxite generates pollution problems in several countries of the Caribbean Region. The most serious water pollution problems are caused during the mining and transportation of the bauxite as the clay material reaches the water bodies.

The following effluent guidelines should be adopted from EPA's regulation (U.S.A. 40 CFR 440):

Pollutants	Max/day (mg/l)	Ave./month (mg/l)
TSS	30	20
Fe	1.0	0.5
AL	2	1
	pH range 6-9	

The mining of nickel ore can cause water pollution problems in the nearby streams and seas, since sediments as well as metals can reach the bodies of water. The following effluent guidelines should be adopted from EPA's Regulation (U.S.A. 40 CFR 440):

Pollutants	Max/day (mg/l)	Ave./month (mg/l)
TSS	30-50	20-30
Cd	0.1	0.05
Cu	0.3	0.15
Zn	1.0	0.5
Pb	0.6	0.3
As	1.0	0.5

Precious metals are generally mined in many countries of the Wider Caribbean Region. This category includes gold, silver and platinum, but the mining operations and mineral processing activities vary from place to place. Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology should be adopted to reduce or prevent the degradation of the nearby bodies of water by point sources:

1. Primary Precious Metals (USA 40 CFR 421.250)

(a) Silver Chloride Reduction Spent Solution

Pollutants	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Pb	0.168	0.080
Hg	0.100	0.040
Ag	0.164	0.068
Zn	0.584	0.244
Au	0.040	-
Oil & Grease	8.000	4.800
TSS	16.400	7.800

pH range 6-9

(b) Calcine Quench Water

Pollutant	Max/day (mg/kg)	Ave./Month (mg/kg
Pb	7.392	3.520
Hg	4.400	1.760
Ag	7.216	2.992
Zn	25.700	10.740
Au	1.760	-
Oil & Grease	352.000	211.200
TSS	721.600	343.200

pH range 7.5-10

(c) Condensed Blowdown

Pollutant	Max/day (mg/kg)	Ave./month (mg/kg)
Pb	5.796	2.760
Hg	3.450	1.380
Ag	5.658	2.346
Zn	20.150	8.418
Au	1.380	-
Oil & Grease	276.000	165.600
TSS	565.800	269.100

pH range 7.5-10

2. Secondary Precious Metals (USA 40 CFR 421.257)

(a) Raw Material Granulation

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	12.05	6.34
Cu (Total)	1.84	0.76
Zn	9.26	3.87
NH3 as N	845.10	371.50
Au	0.63	-
P+	0.63	-
Pb	0.63	-
TSS	259.90	123.60

pH range 7.5-10

(b) Spent Plating Solutions

Pollutant	Max/day (mg/1)	Ave./month (mg/1)
Cu	1.90	1.0
Cu (Total)	0.29	0.12
Zn	1.46	0.61
NH3 as N	133.30	58.60
Au	0.10	-
Pt	0.10	-
Pb	0.10	-
TSS	41.00	19.50

pH range 7.5-10

(c) Spent Cyanide Stripping Solutions

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	7.03	3.70
Cn (Total)	1.07	0.44
Zn	5.40	2.26
NH3 as N	493.2	216.80
Au	0.37	-
Pt	0.37	-
Pb	0.37	-
TSS	151.7	72.15

pH range 7.5-10

(d) Gold Solvent Extraction Raffinate and Wash Water

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	1.19	0.63
Cn (Total)	0.18	0.08
Zn	0.92	0.38
NH3 as N	83.98	36.92
Au	0.06	-
Pt	0.06	-
Pb	0.06	-
TSS	25.83	12.29

pH range 7.5-10

(e) Gold Spent Electrolyte

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	0.017	0.009
Cn (Total)	0.003	0.001
Zn	0.103	0.005
NH3 as N	1.16	0.51
Au	0.0001	-
Pt	0.0001	-
Pb	0.0001	-
TSS	0.357	0.17

pH range 7.5-10

(f) Gold Precipitation and Filtration

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	8.36	4.40
CN (Total)	1.276	0.528
Zn	6.424	2.684
NH3 as N	586.500	257.800
Au	0.440	-
Pt	0.440	-
Pb	0.440	-
TSS	180.400	85.800

pH range 7.5-10

(g) Platinum Precipitation and Filtration

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	9.880	5.20
Cn (Total)	1.580	0.624
Zn	7.592	3.172
NH3 as N	693.200	304.700
Au	0.520	-
Pt	0.520	-
Pb	0.520	-
TSS	214.200	101.400

pH range 7.5-10

(h) Palladium Precipitation and Filtration

Pollutant	Max/day (mg/troy oz.)	Ave./month (mg/troy oz.)
Cu	6.650	3.500
CN (Total)	1.015	0.420
Zn	5.110	2.135
NH3 as N	466.600	205.100
Au	0.350	-
Pt	0.350	-
Pb	0.350	-
TSS	143.500	68.250

pH range 7.5-10

5. Proposed Research, Studies and Legislation

Any pollution control strategy should be based on the water quality of the receiving body of water and the limitations of the discharge of pollutants through point and non-point sources. Effluent guidelines can be effectively used to control the point sources. However, a national permit system for discharges should be

established. Therefore, it is necessary to enact legislation and promulgate regulations to establish and implement a permit system. Control of discharges through effluent standards will be simpler, less expensive and easier to manage than a system based only on water quality standards of the receiving body of water. A combination of effluent standards and water quality standards would provide each country with an adequate pollution control strategy. Thus, the United Nations Environment Programme can develop an International Agreement through the Protocol for Land-Based Source of Marine Pollution in the Wider Caribbean Region and the individual nations can use the water quality criteria and the effluent guidelines to develop their own effluent and water quality standards. It is recommended that the countries of the region follow this approach by enacting national legislation and promulgating water pollution control regulations.

In order to help the nations in the development and implementation of effluent standards, UNEP should undertake research projects to develop some technology-based effluent guidelines which will supplement those suggested for adoption in Part 4.

More specific guidelines are needed for sand and gravel operations, bauxite and nickel mining, and precious metal mining and processing. Also, secondary recovery of metals such as aluminim, copper and lead should be studied to determine if effluent guidelines are needed for these activities. The workshop is specially concerned with the recovery operation of lead from spent batteries and the subsequent pollution generated by the acid and lead discharges.

There is a need to conduct a demostration project(s) related to the techniques which can be used to control the environmental impact of sand and gravel dredging. The main effects of this activity is the turbidity caused by the dredging and the indirect erosion of the beaches. Also, the inland dredging of coastal bays, lagoons and rivers may have adverse effects on the coastal resources. The demostration project should include a review of the available techniques and practices, the selection of those techniques and practices which can be adapted to the region, and the undertaking of one or more demostration projects in the region.

Furthermore, there is a pressing need to perform an inventory and characterize the present mining and metallurgical practices used in the region, emphasizing the wastewater disposal practices.

Finally, there is a need to perform economic analysis of the costs of imposing various levels of effluent limitations on the mining activities and the associated benefits to the environment.

ANNEX VI

RECOMMENDATIONS OF THE CEPPOL REGIONAL WORKSHOP ON COASTAL WATER QUALITY CRITERIA AND GUIDELINES FOR THE WIDER CARIBBEAN

The Workshop:

Having examined the working and reference documents of the Workshop which are contained in the list of documents (Annex III of this report),

Recognizing the importance of establishing suitable and appropriate environmental quality criteria and effluent guidelines,

Recommends that:

1. A review of the available and applied water quality criteria and effluent guidelines and standards be completed by the Secretariat, under the condition that the countries commit themselves to provide the required information.

2. The interim guidelines and criteria proposed by the working groups be considered by the governments of the region for immediate adoption and implementation.

3. The countries of the region contribute to the preparation of a preliminary assessment on land-based sources of pollution reaching the marine environment, by providing the Secretariat with the required estimated information.

4. The research programmes proposed for the development of adequate water quality criteria and effluent guidelines in the region are recognized and implemented.

5. For the Secretariat to consider the planning of epidemiological studies to be conducted in the region to determine the relationship between swimming-associated illness and the densities of various indicators of water quality that are applicable to the region.

6. A review of the technologies for water saving, wastewater management currently in use, as well as of the innovative alternatives, including beneficial uses such as irrigation, fertilization, energy production, aquaculture, etc.

7. A regional network be established to pool and exchange available resources and expertise on water quality criteria, effluent guidelines, adequate technologies, compliance and enforcement monitoring. Moreover, to include a database on institutions of the Wider Caribbean region which are currently undertaking environmental related studies.

8. A public awareness and community education programme be developed on the importance of the water quality and management of waste waters.

9. That one or more institutions from the region be supported as training centres on environmental matters related to water quality criteria and effluent limitations.

CEP Technical Reports

1. *1989.* The Action Plan for the Caribbean Environment Programme: Evaluation of its Development and Achievements (1976-1987).

2. *1989.* Regional Overview of Environmental Problems and Priorities Affecting the Coastal and Marine Resources of the Wider Caribbean.

3. *1989.* Implications of Climatic Changes in the Wider Caribbean Region - Preliminary Conclusions of the Task Team of Experts.

4. *1989.* Assessment of the Economic Impacts of Hurricane Gilbert on Coastal and Marine Resources in Jamaica.

5. *1990.* The Strategy for the Development of the Caribbean Environment Programme.

6. *1991.* Directory of Marine Environmental Research Institutions in the Wider Caribbean Region (English only).

7. *1991.* The Transboundary Movement of Hazardous and Nuclear Wastes in the Wider Caribbean Region - A Call for a Legal Instrument within the Cartagena Convention.

8. *1991.* Report of the CEPPOL Regional Workshop on Coastal Water Quality Criteria and Effluent Guidelines for the Wider Caribbean - San Juan, Puerto Rico, 5-15 November 1990.

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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 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.

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