Clapp

International Bank for Reconstruction and Development

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FROM: Vice President and Secretary

April 17, 1992

BRAZIL
WATER QUALITY AND POLLUTION CONTROL PROJECT

ENVIRONMENTAL ASSESSMENT SUMMARY

1. Attached are environmental assessment summaries of the two investment components of the proposed Water Quality and Pollution Control Project. These components are integrated programs to upgrade water sources in two congested metropolitan areas of Brazil: (i) Guarapiranga waterbasin in Sao Paulo, and (ii) Alto Iguacu waterbasin in Curitiba.

2. The environmental assessments were prepared by the state project beneficiaries, and circulation of the summaries does not signify endorsement by the Bank. The environmental assessments were however reviewed during project appraisal and used to help in developing mitigation plans, which were agreed at negotiations. These environmental assessments were discussed in public hearings and approved by the Brazilian authorities.

3. Questions may be referred to Mr. E. Rodriguez, extension 3-9322. The full environmental assessment reports are available, upon request, from the Office of the Director, LA1.

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PROGRAMA DE SANEAMENTO AMBIENTAL DA BACIA DO GUARAPIRANGA


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GUARAPIRANGA WATERSHED ENVIRONMENTAL SANITATION PROGRAM
ENVIRONMENTAL IMPACT ASSESSMENT

SUMMARY

1. The Guarapiranga Watershed Environmental Sanitation Project is part of a water quality and water pollution control program in Metropolitan Areas of Brazil being promoted by the Ministry of Social Action - National Health Secretariat (MAS/SNS). The São Paulo program has been prepared by the Energy and Sanitation Secretariat as coordinating authority for a working group created on May 15, 1991. In addition to said Secretariat, the State Environment Secretariat (SMA), the Companhia de Saneamento Básico do Estado de São Paulo (SABESP), the Companhia de Desenvolvimento Habitacional e Urbano (CDHU), Eletricidade de São Paulo S.A. (ELETROPAULO) and the Municipality of São Paulo are also executing agencies of this program.

2. A critical event occurred in 1990/91, when proliferation of algae in the Guarapiranga reservoir resulted in taste and odor in the water distributed for public consumption in São Paulo. The State Government, taking into consideration the importance of this reservoir as a source providing potable water to about 3 million people representing about 25% of demand, reacted by creating this program aimed to improve the water quality through environmental recovery of the watershed, control of unplanned use and occupation of land which was the main cause for degradation of the water source.

3. The Guarapiranga Environmental Sanitation Program includes emergency measures to deal with the most critical environmental and sanitary problems in the watershed, plus medium and long-term measures designed to promote proper land use and occupation patterns and integral management of the watershed's natural resources.

4. The funds allocated for the purpose are of the order of US$230 million, 47% of which is being provided by the World Bank. This would be sufficient to obtain a marked improvement in the quality of water and to initiate management of the watershed, but it would not be enough for the full environmental recovery of the area, which will have to be accomplished by further actions based on recommendations emerging from studies which are included in the project

5. Owing to the variety of measures necessary to improve the quality of water in the Guarapiranga reservoir, the program is a complex under-taking which includes different activities which request that various state and municipal institutions be involved. The necessary actions encompass works, studies and the set up of innovative institutional arrangements. These actions are organized and set forth in the following subprograms: Water and Sewerage Services; Collection and Disposal; Urban Recovery, Environmental Protection and Management. All together, these subprograms include 49 activities.

6. The decision to adopt this integrated solution was the most appropriate, since the quality of the water from the reservoir was being affected by a number of different vectors. Despite the possible difficulties in implementation because of its complexity, the program is found to be environmentally economical and institutionally viable compared with other alternatives for supplying water to the São Paulo Metropolitan Region.

7. The environmental analysis of the program was based on the guide-lines laid down by the Office of the Environment Secretary of the State of São Paulo and by the World Bank, with a view to assessing the potential negative impacts from some of the proposed actions. Since the direct purpose of the program is environmental recovery of the watershed, the environmental assessment focused on the program's global performance in relation to its objectives and on specific aspects of the proposed actions, especially the redirecting of sanitary sewers so that they will discharge outside of the watershed and the removal of population from polluted areas.

8. The assessment of the overall project concept highlights the importance of its

institutional aspects for ensuring the success of the project over the long term, with special reference to maintaining satisfactory water quality levels. The institutional aspects include studies, data gathering, and proposed mechanisms and instruments for management of the watershed and its resources.

9. The measures proposed by the program--some of them not yet designed in sufficient detail for implementation--comprise a set of complex and pioneering actions for upgrading and protecting the water source, thus adding a degree of uncertainty which has prompted the scheduling of a mid-term project review at the end of 1993 with the aim of evaluating interim results obtained and being able to correct any unwanted trends. However, the present stage of knowledge, although incomplete in some areas, is sufficient to show that the steps that need to be taken to reverse the degradation process are both environmentally viable and necessary.

10. In the context of the general considerations, the form of use and occupation of the watershed currently observed is incompatible with the requirements of the state Water Source Protection Law in effect, but has reached a scale that makes it impossible to reverse. The program accordingly proposes that this occupation be consolidated by means of investments to upgrade the present sanitation and urban infrastructure on the bases of special existing legislation which allows for exceptions on social grounds. The alternative to the consolidation proposed for the existing urbanization would be the complete removal of people settled in risky areas or in densities incompatible with the protection of the water source. The people are living in favelas (slums) and squatter settlements housing over 77,000 mostly low-income families. But this complete removal was rejected on account of its high social cost for the people expelled and the economic cost of finding land on which to resettle them, bearing in mind that the water source can still be utilized by means of not unduly drastic environmental control and recovery measures and holding resettlement to the minimum strictly necessary.

11. The environmental assessment concluded that the program produces positive impacts on the environmental quality of the watershed and, more specifically, on the quality of the water, while certain negative impacts can be expected if the control measures recommended by the program are not taken.

12. With the implementation of the program, there is an estimated reduction of 45% in phosphate content at the source during the dry period. The reduction in BOD is estimated at 56%. In a more pessimistic analysis, the program should reduce the phosphorus level from 0.12 mg/l (observed in 1990, which was an atypical time in the trend toward eutrophication of the reservoir) to 0.075 mg/l. However, if the average phosphorus concentration over the past five years is considered, the reduction would be from 0.069 mg/l to 0.019 mg/l, hence to comply with the level required by Brazilian rules (0.05 mg/l for bodies of water used for public water supply). It must be stressed that the results of these simulations are only an indication of the efficiency of the project on water quality. A clear indication of the situation should be obtained with the help of the water quality monitoring system included in the program, which will develop a more complete model specifically designed for the watershed that will make it possible to establish parameters for planning and management. In this case other variables will also have to have to be considered, such as the future interconnection of the Capivari-Monos system with the Guarapiranga system, when an additional 2.7 m^3/sec will be brought in (in the first stage) which would bring these phosphorus concentrations down even lower.

13. The investments planned under the program will benefit the four municipalities in the watershed area, thereby appreciably improving living conditions for lowest-income population. About 50% of the program beneficiaries have incomes below US$240 (three minimum wages) and about 75% are below the US$400 (five minimum wages) level. The Project will help reduce the incidence of diseases resulting from lack of sanitary infra-structure and the risks involved with inappropriate housing.

14. The subprojects regarding expansion and improvement of the systems for collecting and treating sanitary sewage will be the

main contributor to the reduction in total phosphorus obtained by the program. The works for disposing this sewage out of the watershed will complement the Tietê Pollution Control Project, another São Paulo State Government initiative, that is to be completed by 1995. The Guarapiranga watershed sanitary sewerage system will be connected with the metropolitan sewage collection and treatment system, thus eliminating the present situation in which the small quantity of sewage currently collected in the watershed is discharged directly into the Pinheiros canal and is pumped to Billings reservoir. In conjunction with these measures, it will be essential that a level of differentiated operation be maintained for the entire system, with introduction of new operating schemes and preventive maintenance. The program accordingly includes actions connected with management of the watershed that are directly designed to bring about operating improvements in the maintenance and operation of the sanitary sewerage systems, with the aim of raising quality to a level compatible with conservation of the spring.

15. The diversion of pollution loads being discharged into the reservoir by the Guavirutuba and Itupu creeks accounted for 20% of the reduction in phosphate obtained by the program as a whole, representing a reduction of 10% of the phosphate load flowing into the reservoir, i.e. a significant improvement over a short space of time and at a relatively low cost.

16. The actions concerning collection and final disposal of solid wastes include the recovery of landfills present in the area by means of bioremediation, thereby removing a further source of pollution in the watershed. The situation regarding waste disposal for three small communities in the watershed is at present absolutely chaotic and uncontrolled with adverse effects on water quality. The São Paulo municipality collects and safely transports solid waste outside of the watershed. In addition to the environmental recovery of the areas degraded by inadequate waste disposal, the EIA concludes that alternatives need to be studied for treatment and final disposal of solid waste that are compatible with protection of the water sources and with the economic and technical training resources of the prefectures benefited, as well as with the prevailing political and legal requirements. This study, based on basic data on real demands and a thorough analysis of the various alternative technologies and possible locations, is being made by the Program Management Unit on a priority basis in view of the urgency of a decision on the most appropriate alternative.

17. The urban recovery actions, together with the expansion of the sewer system, are the steps that require the greatest care in their imple-mentation since the improvements proposed could well induce new settlements and densification of areas already partly settled in the hope of also benefiting from the infrastructure improvements. Both the program and the EIA accordingly recommend that a development plan for the watershed be prepared that should include guidelines for use and occupation of the land, giving incentives for activities compatible with protection of the springs, supported by mechanisms and instruments for managing and controlling settlement that will be applied by the Watershed Management Unit to be set up as a result of the program. This study, which includes the management subprogram, will serve as the basis for actions designed to ensure the environmental sustainability of the watershed and continuity of the emergency measures implemented.

18. The provision of urban services for the favelas, as proposed by the program, will benefit about 15,000 families living under precarious conditions without urban infrastructure. In addition, about 4,000 families will be moved out of favelas in risk areas or ones that cannot be connected to the sewer system. This removal will lessen the density of the favelas to be urbanized so as to enable installation of improvements and public infrastructure systems. These families will be moved into new housing project to be built in close areas located outside of the watershed but near the areas of origin of the resettled people. The housing projects would be better positioned with respect to urban and social infrastructure and employment opportunities since it will be less far from the central areas. Resettlement is always associated with negative impacts such as social conflicts and feelings of insecurity and dissatisfaction among the people concerned. In addition, when the plans are made known, they can attract new people into the

area being cleared who expect that they also will then benefit by being moved into housing projects. In view of these effects and also others of a social nature that could be triggered, the resettlement program includes intensive communication with and participation of the affected population in all stages, from the agreement on the removal conditions to actual resettlement. The Municipality of São Paulo has considerable experience in moving people from risk areas for urban development purposes, and has developed procedures that have shown positive results with only a small number of social problems, which have been resolved by case-by-case negotiations.

19. The main objective of the environmental protection measures is to promote activities compatible with the protection of the water source and the control of inappropriate land use and occupation. The actions proposed includes the replanting over a total area of 1,800 ha and the establishment establishment of a system of parks around the reservoir which will constitute a physical barrier to further urbanization. The parks will help promote awareness among the population on the need for conservation of the reservoir by promoting leisure activities. There are also horticulture, fruitgrowing and forestry-related programs in the area. A weak point here is that these measures all require a relatively long maturation period. In the meantime, it is necessary to preserve the one to count on an efficient system for education of the population and control. The analysis of the effects of the program on water quality showed that this set of actions would help increase the quantity of nutrients carried into the reservoir, but only by a negligible amount (0.5%), while its positive impacts, especially control of unplanned settlement and the spread of urbanization into new as yet unsettled areas, were significant. Moreover, the analysis did not include the mechanisms for controlling release of phosphorus into surface waters, which when implemented will further potentiate the positive impacts of this subprogram.

20. In terms of an overall analysis of the program it must be stressed that the environmental improvement expected will only be fully achieved if all the proposed actions for reorganization of the occupation of the watershed are implemented. The short-term measures will create an improvement that will provide the bases for other, longer-term actions. It must further be emphasized that the corrective measures, in isolation, will not be sufficient to reverse the present deterioration patterns evident in the area. These measures will have to be complemented by integrated planning and management of the watershed, on the basis of the structure of the program itself. The criteria used in defining the forms of action adopted were based on existing economic, social, environmental, legal and politico-institutional factors and considerations.

21. The analysis accordingly concludes that the program is environmentally viable, with significant positive impacts on the environmental quality of the watershed and of the reservoir in particular, and that the recommendations and measures included in the program and highlighted in the Environmental Impact Assessment should be carried out. The specific recom-mendations include the need to implement substantive public sector measures, not only with a view to disciplining and regulating the occupation and use of the watershed but also, and mainly, to promote actions that will foster planned urbanization and especially low density in the watershed area, by establishing physical barriers to further urbanization. In the same way, the expansion of the sanitary infrastructure systems must be strictly in accordance with this planning, which means that connections will not be permitted to existing systems not tied in with the sewage reversal and/or treatment system, neither may new systems be put in that do not meet this requirement. This discipline is covered by the scope of the program, which includes studies of economic activities compatible with protection of the spring and of institutional models for the integrated management of the watershed. These studies will be consolidated into a Development and Environmental Protection Plan for the watershed, which will lay down mechanisms and instruments for the planning and control of occupation of the area with a view to environmentally sustainable development.

PROGRAMA DE SANEAMENTO AMBIENTAL DA REGIAO METROPOLITANA DE CURITIBA

PROSAM

1992

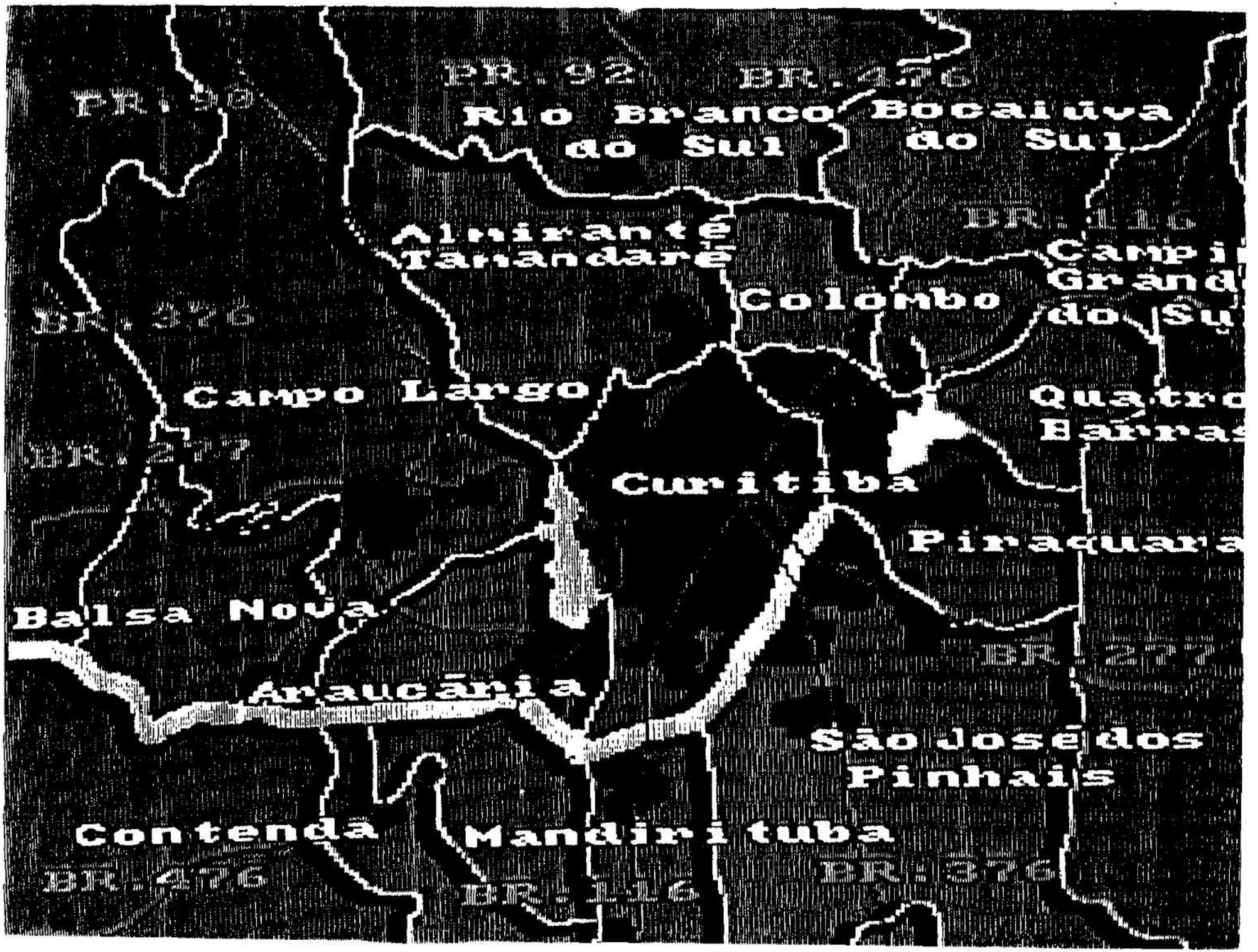
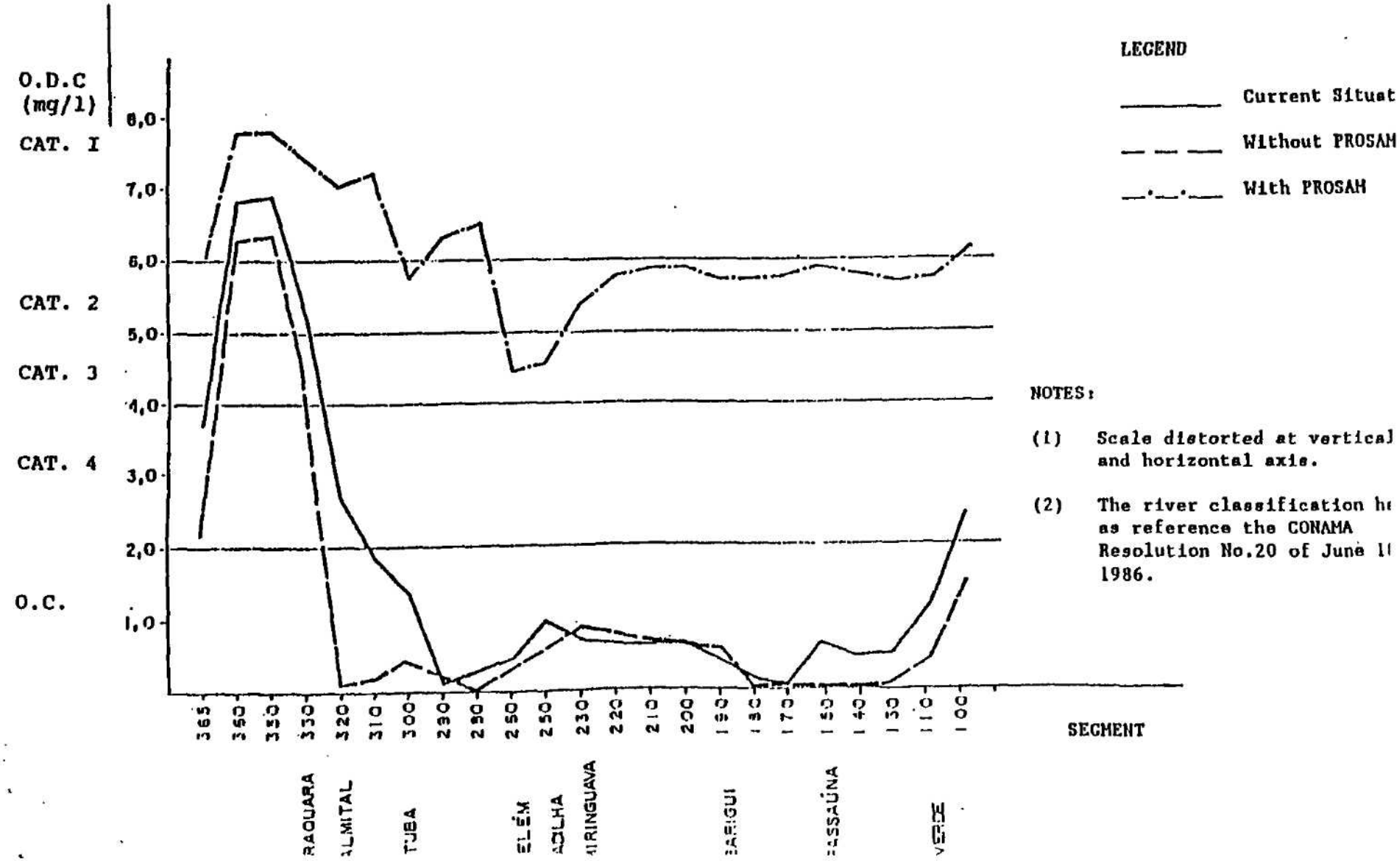

BR. 92
BR. 476
Rio Branco do Sul
Bocaiúva do Sul
Almirante Tamandaré
Colombo
Campo Largo
Curitiba
Piraquara
Balsa Nova
Araucária
São José dos Pinhais
Contenda
Mandirituba

FIGURE I.

CRITICAL DISSOLVED OXYGEN / SEGMENT

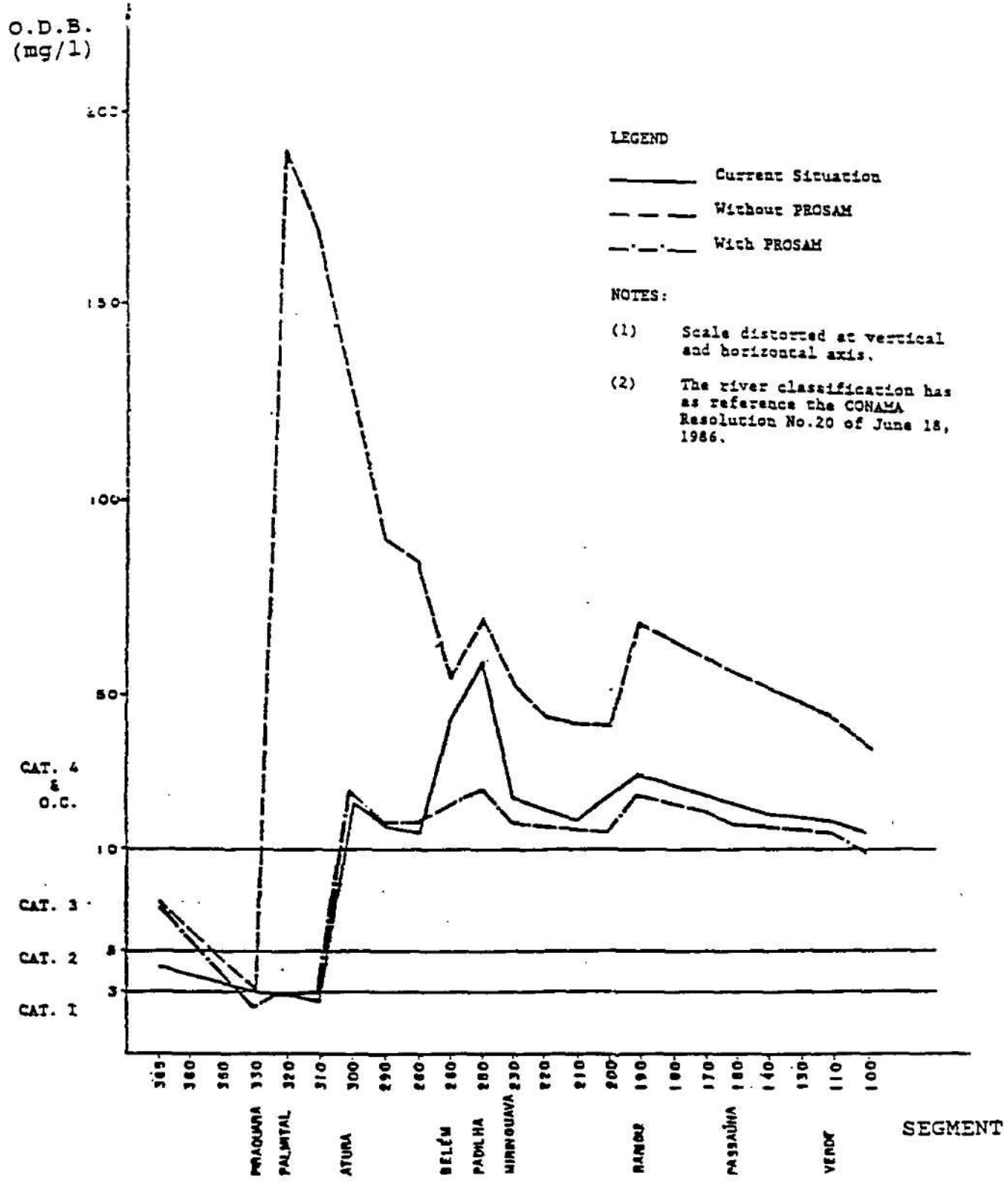


NOTES:

(1) Scale distorted at vertical and horizontal axis.

(2) The river classification h as reference the CONAMA Resolution No.20 of June 1 1986.

FIGURE II ODB / SEGMENT



1.1 Introduction:

The Government of Brazil has requested financial assistance from IBRD for water pollution control projects in metropolitan areas. The State of Parana has been included in the first scheduled operation, for the financing of an environmental sanitation project in the Curitiba Metropolitan Area (CMR).

This project proposes an integrated group of actions addressed to environmental problems originated from the interaction of both the urbanization process and the use of natural resources in the region of upper Iguacu river basin. These problems include: (i) the concentration of low-income population in unsuitable and risky areas, (ii) the lack of sanitation services to keep pace population growth, (iii) the lack of public parks, and (iv) the population ignorance in relation to adequate environment preservation.

To address the above problems, the project will propose the following sub-programs:

(a) Environmental management: provides water quality and pollution control at the water basin scale and includes technical assistance for governmental organizations and NGOs, on planning, monitoring, supervision, and social communication. The sub-program will help integrate sectoral agencies programs and will develop a water sources management structure on the basis of the water basin.

(b) Water resources protection and development: This sub-program is aimed at increasing water supply resources and control of floods, and at re-urbanizing areas close the water sources. These objectives will be achieved, by re-defining land use and recuperating the natural plant cover of the environment, and also include: (i) the construction of a reservoir, (ii) the introduction of new practices for the management of land conservation, (iii) the expansion of areas available for urbanization and natural reservation parks, and (iv) the creation of mechanisms for prevention of highways accidents involving hazardous material in already degraded environmental areas.

(c) Environmental rehabilitation including: (i) flood control related works, (ii) sewage treatment, drainage, the management and expansion of public sewage collectors, (iii) disposal of urban solid waste, and (iv) the development of new public areas for reforestation. The sub-program will permit: 1-the sanitary recovery of Iguacu river, reducing its organic loads discharges and recovering the natural vegetation of the rivers' banks and slopes; 2-the management of solid waste collection and disposal in metropolitan areas, especially surrounding the rivers' banks, and 3-the management control of floods in urban areas using macro and micro drainage.

1.2 Project Features:

The PROSAM program will request investments totaling US$ 223 million; US$ 106 million from IBRD, and US$ 117 million from local counterparts. Annex 25 details the project components, executing agencies and costs.

PROSAM also includes a comprehensive analysis of cost-recovery instruments, such as described below:

Existing Instruments:

- *Water Tariff.*
- *Sewage Tariff.*
- *Property Tax.*
- *Garbage Collection Tax.*
- *State Budget Resources.*
- *Municipal Budget Resources.*

Instruments to be implemented:

- *Leasing of Installations.*
- *Charges for Use of Parks and Installations.*
- *Betterment Taxes.*

Instruments to be Evaluated:

- *Pollution Fee.*
- *Water Usage fee.*
- *Metropolitan Services Tax.*
- *Inter-Municipality Transfers.*

1.3 Project Management

Project implementation will be the responsibility of a management unit (UGP), under the State Planning Secretariat, which will coordinate federal, state and municipal agencies.

This UGP unit will be in charge of the design and administration of projects' agreements, projects' accounting and for their physical and financial supervision.

1.4 The Methodology Applied

PROSAN strategies to evaluate environmental impacts are:

(a) a quantitative assessment of domestic industrial, and agricultural pollution loads;

(b) a quantitative assessment of other indicators;

The analysis covers:

(a) evaluation of current pollution loads and water quality.

(b) different environmental scenarios, in case any action or partial actions are taken;

(c) different environmental scenarios in case the project is implemented;

Since the assessment of the impacts has been done mostly on water quality, the project will address the factors that have the biggest impact on water quality, such as: land use, construction of dams, resettlement of population, solid waste disposal, and river regulation.

The institutional components were analyzed as mitigating measures, given that they do not have a direct impact on the environment.

1.5 Identification of Pollution Sources

*1.5.1. **Organic load** is monitored through two indicators: the dissolved oxygen (DO) and the biochemical oxygen demand (BOD).*

The sources of organic loads are:

- *domestic sewage.*
- *industrial outflows.*
- *lactate from "Lamenha Pequena" sanitary landfill.*
- *storm water.*

Other sources which were not quantified are: the solid-waste disposal on rivers' beds, and the percolation of animal excrements in areas of cattle breeding.

*1.5.2. **Industrial loads:** since the industrial park of the Metropolitan Area of Curitiba (CMR) is composed of food and metallurgical industries rather than of petrochemical or fine-chemical, analysis of industrial loads has been concentrated strictly on heavy-metals. Cyanide was not considered in this case because of inconsistencies found in the data. Nevertheless, given the amount of companies using galvanoplastics, it was necessary to include this product in this qualitative study.*

The overall efficiency of existing treatment stations for industrial wastes was also taken into consideration.

*1.5.3. **Agricultural loads:** land which has suffered organic matter discharges due to agricultural activities is transported and contribute to the silting of the rivers' bed.*

Such impacts have major consequences

as sediments contain agrotoxics and agricultural preservatives which through percolation contaminate ground water and rivers' flows.

Erosion is a relevant issue affecting the Municipalities of Piraquara and Sao Jose dos Pinhais.

*1.5.4. **Numeric Data.** The water quality indicators, OD and BOD, have been estimated for each type of organic load (domestic, industrial, etc) using the simulation model SIMOX.*

The evaluation of current discharges indicates the need for immediate government intervention in order:

(i) to control and organize land occupation, mainly in the Irai, Piraquara Pequeno and Miringuava sub-basins. These sub-basins have already been used, and have potential to be used as areas for water supply.

(ii) to collect and treat the domestic sewage of Curitiba, Piraquara and Sao Jose dos Pinhais, in order to reduce organic load discharges into the rivers.

(iii) to establish policies to control industrial discharges.

Concentrations of agrotoxics close to Irai and Palmital rivers' discharges show high levels of herbicides and insecticides. As a result, it was decided to include these areas as priorities for the control of agrotoxics.

Among other organic charges not quantified, non-natural waste outflows were the most relevant. As of today, the water river of Palmital, Atuba, Belem, Pequeno, Itaqui and Iguacu, between the Palmital and Padilhas are being strongly affected by the solid waste discharges. The existence, in high intolerable proportions, of industrial pollutants such as cyanide, industrial oils and grease, reinforce the need to implement a strong policy for the control of such discharges directly into the rivers.

1.6 Forecasts

The two selected indicators (OD and BOD) have been projected to estimate the environmental situation in the year 2000 under two different scenarios: with and without PROSAM implementation.

Graphs I and II illustrate the current situation and those under two above scenarios.

Results indicate a substantial recovery in water quality, although in some segments the Iguacu river does not reach the desirable quality of Class 2's level.

When considering heavy metals, the estimated values are acceptable. Nevertheless, efforts will be made under the project to strengthen the control of the quality of industrial outflows in this area.

Reforestation and land legislation included in the project will certainly benefit the rivers of the region, protecting them from agrotoxics, erosion, and pollution.

However, in order to achieve an effective reduction of agrotoxics, it is necessary that more aggressive measures be taken in addition to merely identifying distortions in land usage. Within these measures, the following are recommended as:

- decrease in the use of chemical pesticides.

- control of the erosion to avoid phosphate pollution;

- control of infiltration and "run-off" to avoid nitrate pollution;

- control the application of fertilizers.

Estimated results are shown in tables I and II located in the attachment.

Table I, performed with data from figure I, shows that the Iguacu river would attain quality levels suitable for human consumption (Class 1, according to CONAMA) only after the treatment installations included in this project are built.

The water from Piraquara river is not suitable for human consumption, even after full conventional treatment is provided. Without PROSAM, these conditions will deteriorate even further, as it may be observed from figure I.

In the river the conditions will be very much improved. Its water quality may achieve Class 1 levels near Atuba river, Class 2 at Belem river, Class 3 at Padilha river, and to be retained in Class 2 thereafter.

Table II, obtained with data from Figure II, shows the same kind of results as commented above and showed in Table I. Therefore, it can be concluded that with any type of treatment the quality of the Iguacu rivers' water will be inadequate for consumption starting at Atuba river, a point where the river water quality begins to decline into Class 2, falling off any classification thereafter. It can also be noted, that after the implementation of PROSAM, the Iguacu river remains in Class 1 until Palmital river, turning into Class 3 close to Atuba river, when, then, it starts falling off any acceptable classification.

When considering water quality in the river, we have to take into account the following:

(a) The existing and projected water dams are located in points where the water quality turns into Class 3.

(b) Article 13, 20th. Resolution of CONAMA, states:

"The BOD limits established for Classes 2 and 3 may be increased, in cases when studies of self-purification of the river shows that acceptable levels of OD obtained along the river are under any circumstance critical conditions produced by the flow discharged into the mainstream".

1.7. Impact on Water Quality:

1.7.1. ***Organic Loads.*** *The implementation of PROSAM is expected to reduce the discharge of organic loads to about 55 tons/day, which represents a reduction of 65% on the total of organic discharges in the rivers. As consequence we have:*

1- The BOD levels will be close to the limit of Class 3 in the stretch downstream Atuba. Even if this does not represent an ideal situation, it represents an important benefit brought about by the program.

2- In areas close to some SANEPAR's water intakes BODs will be at the level of Class 2 (close to Irai station) and Class 3 (at Iguacu river, upstream of the mouth of Atuba's river).

3- Natural levels of ODs are expected to be re-established by river self-purification, after the water quality falls into Class 1 near Atuba, and Class 2 from Padilha upstream. This fact also represents, according to the Brazilian legislation, that Iguacu river water quality general classification will be at Class 2, even if the values of BOD exceed the limits of this class.

In summary, the implementation of the sanitary municipal sewage sub-component together with an upgraded control of industrial effluent will represent a substantial improvement on the Iguacu river water quality.

1.7.2. ***Industrial Loads:*** *Although industries in Curitiba's Metropolitan Area do not produce hazardous or pollutant ingredients, the implementation of industrial pollution control measures will bring about reductions of about*

50% in the limits of the heavy metal and cyanate presently discharged into Iguacu river. The Iguacu's water quality with such reductions will conform to the class 2 classification, allowing its utilization for water supply after conventional treatment.

*1.7.3. **Other Considerations:** The implementation of PMA-02 sub-component (Land Use and Appropriate Occupation of Rural Areas) which is directly associated with the re-classification plan for using land in protection areas for water sources, will be highly relevant to prevent unacceptable concentrations of herbicides in the rivers Iguacu and Passauna. The reforesting of these mentioned rivers' banks with native plant cover will also bring up important benefit for the reduction of suspended solids in the water, decreasing, therefore, the need for treatment.*

*In addition to the **treatment of domestic sewage** and the **control of industrial discharges of feeder rivers in the region of upper Iguacu river basin**, other sub-components will also contribute to the improvement in water quality:*

a) The Urban Drainage.

b) Disposal of "Lixao da Lamenha Pequena" Sanitary Landfill.

c) The Land Zoning.

d) Basic Infra-Structure.

e) Prevention of Highway Accidents involving Hazardous Materials.

f) Hospital Solid Waste Disposal.

g) Park's Construction.

1.8 <u>Flood Control</u>

The dam to be built has two major functions: as water supply and control of Irai's flows; the river flow regulation will be further achieved by the construction of a canal between Piraquara and Padilhas rivers.

Civil works for the sub-component PRA-02 _Urban Drainage_related to flood control (re-design of the rivers' mainstream course and drainage) are limited to Belem and Atuba (Bacacheri river) because of the lack of a drainage plan for the whole Curitiba Metropolitan Area. The plan might be the critical element to define and locate all required drains and to predict the impact of the Iguacu's canal on the flood regime of the whole basin.

The benefits that the sub-component "Urban Infra-structure and Territorial Reorganization" is expected to generate are pretty obvious, not just considering its technical aspects but also taking into consideration some of its social impacts on public health, as well as the savings generated in terms of public resources needed to fix problems caused by periodical floods which afflict the Curitiba Metropolitan Area (RMC).

The technical benefits of this sub-component are also associated with the necessary reorganization of the whole urban land occupation of the RMC (Curitiba Metropolitan Area), defining rules on land use in areas subject to floods, near the river banks. The expected result is a minimization of the silting up problem that so frequently disrupts the mainstream river flow during the flood season.

A positive impact caused by the sub-component _Reforesting and Rehabilitation of Damage Environmental Areas along Alto Iguacu Basin_ is directly associated with the recuperation of the natural plant cover on the river banks, which will reduce erosion, and will avoid the silting-up of the rivers' bed, and freeing the mainstream flow.

2. MITIGATION ACTIONS

The following section of the report analyzes the array of actions prescribed by PROSAM. The program is made of several sub-

components, better known as institutional projects, which in reality are actions to guarantee the successful achievement of the major project objectives.

2.1 General Actions:

In order to achieve effective implementation of PROSAM it is important to identify all direct and indirect participants and to define and adequate plan of actions, such as described below.

1_ The Project Management Unit of PROSAM;

2_ The public agencies responsible for the implementation of the sub-projects, such as: Municipality of Curitiba, COMEC, SANEPAR, SUREHMA, SECEAM, EMATER, ITCF, DER, and other minor municipalities.

3_ The Population as individuals, or its legal representatives.

4_ In order to be able to achieve projects objectives, it is necessary to have strong coordination among the various agencies and sub-components. The key element to successful implementation of the program will be the Project Management Unit, which will have to manage multi-disciplinary sectoral projects, and conciliate all participants interests to that of the public interest. To this end, the following sub-components are very important:

-PGP-01 - Program Management.
-PEB-01 - Technical Support.
-PEB-02 - Management System of Alto Iguacu Basin.
-PEB-03.2 - Governmental Information System.
-PEB-03.1 - Project Remote Sensing System.
-PEB-09.2 - Environmental Education- City of Curitiba Administration.
-PEB-09.1 - Environmental Education - State of Parana Administration.
-PEB-03.3 - Environmental Information Agency for the Curitiba Metropolitan Area (RMC).

2.2 Specific Actions:

PROSAM has been developed to solve two major environmental problems in Curitiba's metropolitan area: 1-the management of water sources protection areas; and 2-the control of floods in the region. The specific lines of action are:

2.2.1. <u>Management of the Water Sources Protection Areas:</u>

1_ management of water quality.

2_ management of land use in areas of water supply.

3_ management of Pollution in areas of water supply.

The sub-components addressing the above are:

1_PEB-08 - Monitoring and Control.

2_PEB-06 - Territorial Organization of the Areas of Water Supply.

3_PEB-07 - Study, Evaluation and Utilization of different areas of water supply systems.

The collection of data for these sub-components fall under of the following areas:

1_PEB-08 - Monitoring and Control.

2_PEB-05 - Developmental Program for Adequate Economic Activities in Areas of Water Supply.

It is very important to observe that the latter (PEB-05) is an innovative program in Brazil and one of the first to clearly evaluate economic activities and technological

applications that best fit the occupational needs of water supply regions.

*2.2.2 **Flood Control.***

According to comments made in the last item 2.2.1, the sub-components necessary for the control of the rivers' flood regime are:

1_PEB-04 - Drainage Directive Plan

2_PEB-02 - Alto Iguacu Basin Management System.

Conclusions:

The main conclusion of this work is that PROSAM fulfills all requirements for setting up an efficient water basin management. The design of its sub-components promotes integration among participants, clearly defining global and specific implementation strategies, showing also how to collect data or and analyze the expected results.

For the point of view of the environment surrounding water sources, the design of PROSAM also reveals serious concerns for the protection of the soil and natural vegetation. For the economic perspective, PROSAM does not reflect necessarily high maintenance costs or a heavy fiscal burden on the tax-payers.

Recommendations:

General recommendations for further implementation of PROSAM development are:

a) to present all sub-component designs, clearly defining benefits and social impacts.

b) to coordinate all related sub-components such as: flood control, industrial pollution of water supply, environmental preservation of natural plant cover and amusements parks.

c) to elaborate the respective EIA's (Environmental Impact Studies) and RIMA's (Impact Reports on Environment) after the development of each sub-component.

d) to create a monitoring system to continuously evaluate the development of each sub-component.

Table I
Iguacu river - ODB
River water quality classification

River Segments	River Classes		
	Actual	W/out PROSAM	With PROSAM
Piraquara	1	2	1
Palmital	4	OC	1
Atuba	OC	OC	1
Belem	OC	OC	2
Padilha	OC	OC	3
Miringuava	OC	OC	2
Barigui	OC	OC	2
Passauna	OC	OC	2
Verde	OC	OC	2

Table II
Iguacu river - BDO

River Segments	River Classes		
	Actual	W/out PROSAM	With PROSAM
Piraquara	1	2	1
Palmital	1	OC	1
Atuba	OC	OC	3
Belem	OC	OC	OC
Padilha	OC	OC	OC
Miringuava	OC	OC	OC
Barigui	OC	OC	CO
Passauna	OC	OC	OC
Verde	OC	OC	OC

Resolution 20/CONAMA

Classification	OD mg/l	BDO mg/l
Class 1	6.0 or higher	up to 3.0
Class 2	5.0 to 5.9	3.1 to 5.0
Class 3	4.0 to 4.9	5.1 to 10.0
Class 4	2.0 to 3.9	---
Out of Class (OC)	1.9 or less	10.1 or higher