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PREPARATION OF INDUSTRIAL ASPECTS OF NATIONAL REPORTS FOR THREE COUNTRIES (ARGENTINA, EGYPT, THAILAND) FOR THE 1992 UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT

US/INT/90/281

Part II: Argentina*

Prepared for the Government of Argentina
by the United Nations Industrial Development Organization

Based on the work of W. A. Palmer,
UNIDO consultant

Backstopping officer: Muki Daniel,
Environment Co-ordination Unit

* This document has not been edited.

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Introduction

This report presents the outcome of a consultant mission to Argentina funded by the United Nations Industrial Development Organization. The purpose of the mission was to provide assistance to the government Argentina in preparing the industrial aspects of the Argentine national report for the United Nations Conference on Environment and Development (UNCED). The mission consultant was Walter A. Palmer of Environmental Resources Limited.

The report is organized into three sections: 1) A chronological summary of consultant activities during the in-country portion of the mission, June 18 through June 30, 1991; 2) An account of the UNCED report preparation process in Argentina and the input of this mission to this process; and 3) An identification of future actions needed in order to prevent and mitigate environmental degradation resulting from industrial activities. The written section of the Argentine national report for UNCED prepared by the mission consultant while in Argentina is attached to the present report as an appendix.

Chronological Summary of Activities

June 18

- Arrival in Buenos Aires approximately 2:00 pm
- Meeting with Architect Alberto Barbuto and Dr. Vincent Barros, Comision Nacional de Politica Ambiental (CONAPA). Orientation regarding the ongoing UNCED report preparation process; discussion of the information required for the preparation of the industrial aspects of the report (based on a

proposed outline of the industrial section of the report presented by the mission consultant); discussion of the manner in which the mission and mission consultant could provide greatest assistance in the preparation of the industrial section of the UNCED report.

June 19

- Meeting with Dr. Barros and other professionals and support personnel at CONAPA involved in the preparation of the UNCED report. Discussion of individual roles, the mission consultant's input, and general availability of data required for the mission.

- Review of written data and information provided by CONAPA; discussion of this information and further information requirements with Dr. Barros.

June 20

- Meeting with Luis Soto-Krebs, Director, and Ronald Goldberg, Professional Officer, UNIDO/Buenos Aires. Discussion of purpose of mission, data requirements, and potential data sources.

- Meeting with Ms. Katica Cekalobic, Resident Representative, UNDP/Buenos Aires, and Mr. Soto-Krebs. Discussion of purpose of mission, data requirements, potential data sources, and UNDP involvement in the UNCED report preparation project.

- Further discussions at CONAPA regarding the industrial section of the UNCED report, data requirements and availability, and arrangements to meet with Francisco Leiva, a consultant preparing economic analysis sections of the UNCED report.

- Meeting with Architect Marta Balderiotte de Segui (Directora National), Carlos Druiz, Herman Alonso, and Alexandro Isaria, of Direcion Nacional de Ordenamiento Ambiental (DNOA). Discussion of the UNCED report, purpose of the mission, data requirements, and data held by DNOA.

June 21

- Meeting with Engineer Luis Trama, Director de Investigaciones Industriales, Instituto Argentino de Siderugia (Argentine Iron and Steel Institute). Discussion of the Argentine iron and steel industry, associated environmental programs and problems, and associated policy and institutional issues.

- Meeting with Mr. Druiz, Mr. Alonso, Mr. Isaria of DNOA. Review of data available at DNOA, and translation and review of information provided by CONAPA.

- Meeting with Mr. Rosenberg UNIDO. Discussion of possible contacts for further data, planning of meetings with these contacts.

- Meeting with DNOA personnel; further translation and review of information provided by CONAPA. Discussion of additional possible data sources.

June 22, 23, 24 (Saturday, Sunday, and Argentine national holiday; all offices closed)

- Review of Spanish and translated materials provided by CONAPA, DNOA, Instituto Siderugia, and UNIDO. Preparation of preliminary draft of UNCED report section regarding environmental impacts of Argentine industry.

June 25

- Discussion of preliminary draft report section prepared by the mission consultant dealing with industrial impacts on the environment, and other sections of the UNCED report dealing with Argentine industry under preparation by other consultants (geographic distribution and trends, economic trends, policy and institutional issues) with Dr. Barros at CONAPA.

- Meeting with Mr. Carlos Mallmann, Centro de Estudios Avanzados, Universidad de Buenos Aires (an environmental consultant and researcher in the area of environment, suggested by Mr. Soto-Krebs as a source of information). Discussion of the general environmental situation in Argentina, industrial impacts on the environment, and associated economic, political, institutional, and policy issues.

- Information review and report preparation at CONAPA.

June 26

- Meeting with Roberto Barga (Gerente General), Gustavo Braier (Subgerente General), and Graciela Boeri, Associacion de Fabricantes de Celulosa y Papel (pulp and paper manufacturers' association). Discussion of the Argentine pulp and paper industry, associated environmental programs and problems, and associated policy and institutional issues.

- Meeting with Mr. Rosenberg and Mr. Soto-Krebs, UNIDO. Discussion of mission progress, and possible further data sources and contacts.

- Meeting with Jorge Mentruit (Ecologia y Sistemas Ambientales) and Alejandro Querejeta (Public Relations), staff of Siderca SAIC and representatives of Union Industria Argentina. Discussion of environmental programs and problems at Siderca (one of the largest iron and steel companies in Argentina), and of industrial/environmental issues, policies, institutions in Argentina in general.

- Discussion with Dr. Barros at Conapa regarding the sections of the UNCED report dealing with Argentine industry under preparation by other consultants (geographic distribution and trends, economic trends, policy and institutional issues).

June 27

- All-day meeting with Dr. Barros and Francisco Leiva (economic advisor to the Finance Ministry, Province of Mendoza, Professor, University of Mendoza, and consultant preparing the economic analyses for the UNCED report). Discussion of a preliminary draft (prepared by Mr. Leiva) of economic aspects of the industrial section of the UNCED report; discussion of economic and industrial development in Argentina, and related industrial geographic distribution, policy, institutional, and environmental issues.

June 28

- Meeting with Alberto Moran, Subsecretario de Medio Ambiente, Secretatia de Salud y Medio Ambiente, Municipalidad de la Ciudad de Buenos Aires, and Ronald Goldberg, UNIDO. Discussion of environmental problems related to industrial activity in Buenos Aires and vicinity.

- Meeting with Ms. Katica Cekalobic, Resident Representative, and Eva Tlusti, Official de Programma (and environmental focal person),UNDP. Review of mission progress and preliminary findings. Discussion of observations regarding environmental policies and institutions in Argentina, and the possible role of UN agencies in assisting in the development and strengthening of same.

- Meeting with Engineer Carlos Bruno, Quimica Hoeschst S.A. Discussion of the Argentine chemical industry, related environmental programs and problems, and associated policy and institutional issues.

June 29 and 30

- At CONAPA all day both days. Review of assembled information; preparation of final draft of UNCED report section regarding industrial impact on the environment; discussion with Dr. Barros of other sections of the UNCED report dealing with Argentine industry (geographic distribution and trends, economic trends, policy and institutional issues).

Argentine UNCED National Report Preparation and Mission Input

The coordinator of the project to prepare the Argentine UNCED national report is Dr. Vincent Barros of CONAPA. At the time of this mission, report preparation was at an advanced stage. Dr. Barros had requested input from various national, provincial, and municipal government institutions (and had received input from some of these), had several CONAPA staff members working on the report, and in addition had 11 outside consultants preparing various aspects of the report. These consultants were all Argentine nationals; their participation was funded by UNDP. Total draft UNCED report text was estimated at about 600 pages.

Optimal input by this mission to the UNCED report preparation process was defined early in the mission through discussions between the mission consultant and Dr. Barros of the outline for the industrial section of the report prepared by the mission consultant prior to the mission (based on the mission terms of reference and outlines and guidelines prepared by the United Nations' UNCED Preparatory Committee), and Dr. Barros' progress on and planning for the completion of the UNCED report.

Main factors defining this mission's input to the UNCED report were as follows:

- consultants had been retained by CONAPA for, and were in the final stages of, preparing several sections of the UNCED report included in the terms of reference for this mission (i.e., sections dealing with: numerical, geographical distribution, and economic trends in Argentine industry; and policies and institutions pertaining to industry and environment);

- Dr. Barros did not want this mission to provide any written input in the areas already covered by these ongoing consultancies;

- specific sections of the UNCED report for which assistance was requested from this mission were: the section dealing with industrial impact on the

environment; and the section dealing with associated health and ecological effects;

- data for these sections had not been collected by CONAPA prior to the beginning of this mission (CONAPA was not expecting the mission at the time it took place); efforts to collect pertinent data during the mission by the mission consultant and various people in CONAPA, DNOA, UNIDO, UNDP, and others resulted in the identification of a small amount of pertinent data; and

- all information collected and reviewed during this mission was in Spanish; interviewees generally spoke Spanish, and the UNCED report was being prepared in Spanish.

Because written input was desired by the host country report coordinator for only two specific sections, and because the report was being prepared in Spanish (the mission consultant does not write Spanish), the majority of the input to the UNCED report preparation process provided by this mission was verbal rather than written.

This verbal input consisted of discussion and verbal review of those sections of the UNCED report included in the TORs of this mission but already under preparation by CONAPA consultants. The mission consultant's outline for these sections (prepared prior to the mission based on the mission terms of reference and outlines and guidelines prepared by the United Nations' UNCED Preparatory Committee) was reviewed, expected components of these sections were considered, and in most cases the availability of data and CONAPA/CONAPA consultant plans and progress in preparing each component were discussed. Based on these discussions, it appeared that preparation of these sections of the report was progressing in a manner consistent with the goals of UNCED, although in some cases the CONAPA outline varied from the UNCED Preparatory Committee suggested outline, and in many cases the lack of data was a significant limiting factor.

Written input to the UNCED report resulting from this mission consisted of sections dealing with industrial impacts on the environment, and associated human health and ecological impacts. A considerable portion of the time available during this mission was devoted to a concerted effort to uncover data pertaining to these subjects. The data found, while suggesting substantial environmental degradation and related human health risks associated with industrial activity in many areas, were nevertheless inadequate to thoroughly characterize the impact of industrial activities on environment in Argentina. Lack of data was therefore a major limitation in the preparation of the written input described above. As necessitated by time limitations, and as requested by Dr. Barros (in view of the fact that this section would be translated into and finalized in Spanish) this written input was prepared and submitted in draft form. The written section of the UNCED report prepared by the mission consultant and submitted to Dr. Barros is attached to the present report as an Appendix.

Further Action Required

The following is a brief identification and outline of areas in which action is needed (and on which international assistance could be focussed) in order to bring about a reduction in and more effective control of industrial impacts on the environment in Argentina. This section is based on the review of data provided by CONAPA and from other sources, and interviews of government environmental employees, industrial representatives, and environmental consultants/researchers in Argentina. The appendix to this report presents an overview of current environmental policies and institutions as they pertain to industry in Argentina; this overview serves as a background for the required actions identified here (detailed descriptions and analyses of environmental policies and institutions are under preparation for the UNCED report by CONAPA and CONAPA consultants).

It should be noted that the following merely attempts to identify those initiatives that are needed; analysis of the costs and benefits of the listed initiatives, and comparison of their costs and benefits to those of other development priorities, are beyond the scope of this report but would be a desirable prerequisite to the adoption of the following initiatives.

Policy

Industrial environmental policy should be considered in the following areas:

- environmental impact assessment; requiring examination of the potential environmental impacts, identification of alternatives for reducing these impacts, and assessment of the full costs and benefits (including environmental externalities not currently considered) associated with industrial developments likely to have environmental impact;

- toxic/hazardous substance and hazardous waste management; defining hazardous and toxic substances and hazardous wastes, establishing a notification and record-keeping system allowing "cradle-to-grave" mass-balance tracking of toxic and hazardous substances, establishing regulations for the handling of these substances and ultimate disposal of hazardous wastes by manufacturing industries and by the waste management industry;

- emission standards; technology- and/or risk-based standards for end-of-the-pipe and end-of-the-stack contaminant emission levels should be developed based on a realistic assessment of the technology available to Argentine industry (standards currently exist, but these should be expanded to cover a wider range of contaminants, should be standardized nationwide, and should be rationalized based on the risks posed by industrial emissions to human health and to

wildlife and other natural resources). The adoption of such a policy presumes the enhancement of monitoring capabilities: see below;

- industrial safety and catastrophic accident prevention and mitigation; policies setting standards for and requiring: industrial safety programs, public information, and emergency response programs for industries handling quantities of hazardous substances large enough to pose major hazards to the surrounding community and environment in the event of an accident;

- a system of penalties or sanctions for violations of environmental regulations by industry which are commensurate with the degree of environmental degradation caused, and present effective incentives to comply with regulations; and

- other financial instruments (such as user fees) designed to internalize the costs associated with environmental degradation, and to encourage environmentally sound practices by industry.

Programs

Waste Management. The current lack of an industrial waste management program was cited by several industry representatives and Argentine environmental experts as a contributing factor to contamination of land, air, and water resources. A comprehensive waste management program is needed, including:

- a survey of industrial waste arisings (volumes, types, and regional patterns; including both hazardous and inert industrial wastes);

- identification and development of the required collection, transport, holding, and disposal capacities for inert solid wastes, including development of controlled sanitary landfill facilities;

- determination and development of the management/treatment processes and capacities required for toxic and hazardous wastes;

- institution of measures (policies, programs, and physical facilities) to separate different categories of wastes, and channel these to appropriate management streams;

- identification of recyclable or reusable waste materials, and assessment and development of the appropriate recycling/reuse processes;

- development of the policies and institutions required to implement the above measures.

In addition, current waste disposal practices, and the possibility that these practices have resulted in environmental degradation and have created current and future environmental hazards, should be investigated. If necessary, a program of hazardous site cleanup should be instituted.

Industrial Emission Inventory and Quantification. Efforts to characterize, quantify, and ultimately to control industrial impacts on the environment are significantly hampered by a lack of centralized, comprehensive data on industrial emissions. While some data in this area are held by industrial organizations, NGOs, and national, provincial, and municipal government bodies, the readily available data are limited in detail, and scattered in their coverage. Little or no data are available for the majority if Argentine industry. A comprehensive program is needed to:

- identify industrial activities and establishments releasing significant environmental emissions;
- survey these industries (or a representative sampling of these industries) using one or a combination of methods including questionnaires, interviews, and site inspections, sampling and analysis, analysis of production/waste ratios, or others, and characterize and quantify industrial emissions;
- develop a data base allowing analysis of industrial emissions nation wide by industry, or by region, metropolitan area, watershed, river reach, pollutant type; and
- implement a requirement for reporting by industry of new or significantly changed emissions likely to have significant environmental impacts.

Environmental Monitoring. A program of comprehensive environmental monitoring, is needed. The goals of such a program would be a thorough characterization of environmental quality, and development of data adequate for the for the assessment of potential human health and ecological impacts associated with industry, and tie identification and prioritization of environmental hazards. Development of such a monitoring capability would involve:

- acquisition of appropriate, state-of-the-art sampling and analytical equipment;
- development of institutional capabilities to plan effective, prioritized monitoring programs, to perform sampling, sample management, and analysis, and to process and analyze the environmental quality data generated; and
- training of monitoring agency staff in state-of-the-art sampling and analytical techniques, and in the use of the installed equipment;

- preparation of a prioritized monitoring program, focussed initially on areas deemed most likely to exhibit high contaminant concentrations, and to be associated with significant human exposure and human health risks.

Institutions

Institutional development and strengthening at should focus on the enhancement of existing capabilities, and development of new capabilities where necessary, to implement the above-suggested environmental legislation and waste programs. This includes the development of focussed, specific functional groups and centers of expertise. For example, institutions should be developed that are devoted to, and have a high level of expertise in:

- industrial pollution control and emission reduction engineering;
- inert industrial waste management;
- hazardous/toxic substance and hazardous waste management;
- environmental impact and human health risk assessment;
- industrial safety and catastrophic accident prevention/mitigation;
- environmental economics and policy, including development and assessment of fiscal instruments for encouraging environmentally sound industrial development; and
- environmental monitoring.

Environmental institution development/strengthening should involve a training program for environmental institution staff, providing specialized training in state-of-the-art methods and technology. This training program should include upper management (providing an overview of environmental policy and implementation approaches); middle management (providing both an overview of approaches to environmental management, and a comprehensive review of applied techniques in specific areas), and environmental professionals (providing in-depth training in applied assessment techniques in specific areas).

APPENDIX

Mission Written Input to the Argentine National Report for Unced

NOTE: The following document was prepared by Walter A. Palmer of Environmental Resources Limited, under contract to the United Nations Industrial Development Organization, Vienna, Austria. The purpose of this document is to provide assistance to the Government of Argentina in the preparation of the Argentina national report for the 1992 United Nations Conference on Environment and Development.

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Industrial Pollutant Loadings

The diverse industrial activities in Argentina, as described in the previous section (analysis of industrial development and geographic distribution of industry) generate a wide variety of solid, liquid, and gaseous wastes. A large portion of these wastes are released directly to the environment in the form of liquid effluents and atmospheric emissions, or (in the case of solid wastes) are disposed of in a manner resulting in the release of pollutants to the natural environment. These releases from industrial activities result in significant degradation of air, water, and soil quality in industrial areas and in the nearby or downstream environments.

1. Factors Affecting Industrial Impacts on the Environment

Several policy, institutional, economic, natural resource, and climatological factors have had an important bearing on the evolution of industrial impacts on the environment over the past two decades, and continue to affect the rates of industrial pollutant releases and the impacts of these pollutant loadings on the environment today. These factors are described and analyzed in some detail in other sections of this report, and are therefore summarized briefly here from the standpoint of their effects on industrial pollutant loadings to the environment.

1.1 Policy and Institutional Factors

As described in the section regarding environmental policies in Argentina, policies pertaining to industry are minimal and (owing to the lack or ineffectiveness of implementing institutions) largely ineffectual. National air and water quality standards have been promulgated but, in the case of water quality standards, implementing regulations have not been drafted. These standards are limited in scope (covering only the most common liquid and

gaseous waste types), and no agency exists at the national level with the authority or capability to enforce compliance by industry with these standards.

Under the national tax laws designed to promote industrial development in selected, underdeveloped areas of the country, the environmental impacts of industries applying to take advantage of the promotional program are to be reviewed, and mitigating measures are to be implemented where necessary. This process has led to the inclusion of pollution control or waste management measures in the design of some new industrial facilities. But implementation of this policy has not been consistent; many examples exist of industrial development conducted under this program with inadequate or nonexistent environmental safeguards.

This same policy promoting the location of industries in undeveloped areas has brought about a geographic concentration of environmental impacts in areas outside of the major metropolitan areas. Although these policies have resulted in the dispersal of industry outside of the metropolitan areas (reducing the concentration of impacts in these metropolitan areas), the policies have generally led to the clustering of industries in industrial parks within the areas promoted for industrial growth. Thus, industrial impacts on the environment are concentrated in the areas surrounding these industrial complexes.

Under Argentina's federal system direct regulation of industrial impacts on the environment has been relegated to provincial governments. Several provinces which have significant industrial activity have promulgated air and water quality standards and/or effluent standards, and implementing agencies have been developed in some cases. But these environmental policies are again limited in scope, and implementing agencies are again largely ineffective due to lack of funding and qualified personnel. The variation in environmental requirements among provinces increases the difficulty of environmental compliance for firms operating in several provinces.

Aside from a national policy governing the transport of dangerous materials, no policies exist pertaining to solid or hazardous industrial waste management at any level of government, and no facilities exist in Argentina for the sound management of these wastes. As a result little is known about the generation patterns of such wastes or of current waste management practices. It is known that in many cases solid and hazardous wastes are disposed of through clandestine dumping, illegal disposal in municipal landfills, and mixture into domestic sewage collection systems.

In brief, then, industry in Argentina is effectively unregulated with respect to environmental impact. This is not to say that no environmental safeguards have been implemented, however. Some of the more environmentally responsible firms have recognized the need for self-regulation with respect to environmental impacts, and have installed pollution control equipment and taken measures to manage hazardous wastes in a sound manner. These firms are in the minority, however. Pollution control devices installed by these firms range from state-of-the-art, full treatment systems to primary, physical control systems (settlers, clarifiers, particulate removal systems) which do not control chemical,

nutrient, or microbiological contaminants. The latter, more basic type of treatment system is most common among the minority of firms that treat their wastes. Hazardous waste management practices are generally limited to controlled waste storage.

1.2 Economic Factors

The Argentine economy took a strong downturn beginning in 1974, and has been in a state of stagnation for most of the last two decades (as analyzed in the foregoing section dealing with economic trends in Argentina). The industrial share of GNP has dropped significantly during this period, and investment in industry as a function of GNP has been very low. Production and employment in many of the major industries (e.g., the textiles, machinery, automotive, and cement industries) has dropped and a significant proportion of industrial firms have closed (14% between 1974-1985). As a result, the capital available for financing pollution control equipment has been limited, and the updating of environmental safeguards has largely been forgone by Argentine industry during this period.

The economic stagnation and contraction of the industrial sector has also led to a general concentration of industrial activity. The resulting predomination of large-scale industrial enterprises causes a geographic concentration of industry-related environmental impacts.

During the past two decades several new industries have been established and become important, and production of some of certain previously-established industries has increased. These growth industries include the food preparation, basic metals, chemicals, petrochemicals, pulp and paper, iron and steel, and plastics industries. All of these growth industries are highly polluting industries, and their growth has been accompanied by a significant increase in the potential for pollution of the environment by Argentine industry.

Minimal environmental monitoring or regulation of industrial development, and few incentives for development of environmental safeguards, have meant that the installation of pollution control or waste management facilities within these growth industries has been the exception (as outlined above).

1.3 Natural Resource Factors

General industrial location patterns in Argentina are covered in detail in the foregoing section regarding industrial development. As this earlier section indicates, the great majority of industry is located in or near major metropolitan areas (in 1984 the three metropolitan areas of Greater Buenos Aires, Rosario, and Cordoba accounted for 63% of industrial production).

Outside of the major metropolitan areas, however, the location of industry has been largely governed by the availability of required natural resources, principally water resourc-

es. Particularly in the western provinces water resources are confined to a small number of rivers. This has meant the concentration of industries in corridors along these rivers, and a consequent concentration of environmental impacts in these corridors and rivers. Many of these rivers have relatively low flows (in the order of 10 cubic meters/second), and therefore have a limited capacity for the assimilation of wastes.

1.4 Climatic Factors

Weather patterns in the region surrounding Argentina result in a near-constant flow of moderate to strong winds over the country. Stable temperature inversions generally develop to the west of the country over the Pacific Ocean and Chile, and to the northeast of the country over the Atlantic, but rarely develop over Argentine territory. This pattern and the resultant winds enhance the dispersion of atmospheric pollutants in most areas of Argentina, and therefore reduce the severity of industrial atmospheric emission impacts on the environment.

For this reason, industrial impacts on air quality are generally regarded as less important than impacts on water and soil. Nevertheless, significant atmospheric pollution by industry is thought to occur in certain localized areas (described below).

2. Types and Quantities of Industrial Pollutant Loadings to the Environment: National Overview

2.1 Data Availability

As a result of the minimal environmental regulation or monitoring of industry by the government, very little information or data have been generated and are available in the public domain pertaining specifically to industrial pollutant loadings to the environment. Existing data are scattered in their coverage, are mostly developed by provincial governments, and are therefore on a provincial or local basis (with the notable exception of some river basin-specific data assembled by the Greenpeace organization).

Most available data pertain to liquid effluents released to surface waters, and focus on basic nutrient, physical, and inorganic chemical parameters. In many cases the effects of industrial, agricultural, and domestic liquid pollutant loadings are indistinguishable. Very little data regarding water contamination by organic chemicals or atmospheric pollutant loadings are available, and no data regarding groundwater or soil contamination by industry are available.

A comprehensive assessment of industrial pollutant loadings to, or impact on, the natural environment in Argentina is therefore not possible. A general indication of the degree of importance of this issue is provided, however, by the nation-wide data which are available, and by examination of available data pertaining to representative industrialized areas.

2.2 Characterization of Industrial Pollutants and Wastes

The following is a list of major wastes likely to be generated by Argentine industries, itemized according to industrial activity (source: De Felippi, undated; World Bank 1988);

- **Basic metals, metal processing, and machine industries:** detergents, several types of acid solutions, heavy metals (arsenic, zinc, lead, copper, nickel, etc.), ammonia, cyanide, phenols, fluoride, sulfide, oil and grease, and miscellaneous hydrocarbons, sulfur dioxide, nitrogen oxide fluoride, and hydrogen sulfide gases, and fine particulate matter.

- **Tanning industry:** chromium, sulfur, sodium hydrosulfates; oxalic acids, nitrogen compounds, ammonium carbonates, aluminum and potassium sulfates, amines, pigments, organic materials, nutrients, and microorganic pathogens;

- **Pulp and paper industries:** sulfides, organic materials, methylmercaptans, phenols, bleach wastes, dioxins;

- **Food industry:** organic materials, nitrogen compounds, sodium compounds, ascorbic, citric, and lactic acids, microorganisms;

- **Refinery and petrochemical industries:** lead, mercury, cobalt and other heavy metals, semisolid aromatic hydrocarbons (benzene and derivatives), aliphatic hydrocarbons, detergents, oils;

- **Textile industry:** acids, sulfur compounds, detergents, dye compounds, heavy metals, hydrocarbons;

- **Chemical industry:** a wide variety of residues, including residues of alcohol, ester, glycerine, plastifiers, peroxides, pigments, polyester resins, polystyrenes, CFCs, etc.

- **Sugar and alcohol industries:** organic wastes, salts of potassium, sodium, sulfur, and chlorine, atmospheric particulates.

Most of the wastes listed above are most likely to be disposed of in liquid effluents. Potential atmospheric contaminants include volatile organic compounds (e.g., benzenes, certain hydrocarbons, alcohols,etc.), volatile heavy metals (e.g. mercury and lead under certain conditions) other gases as specified, and fine particulates released in stack emissions or as the result of fuel burning. Possible solid wastes include organic wastes from the food, tanning, paper, and sugar and alcohol, and slag, cinder, and other solid wastes from the basic metals and metal finishing industries.

2.3 Quantities of Industrial Pollutants

Estimates of nationwide industrial pollutant generation rates are available only for oxygen demand loadings in liquid effluents, and only for a subset of Argentine industries. These data are presented in Tables 1 through 5. Data in these tables pertain to the oxygen demand associated with nutrient and organic wastes in effluents from the alcohol, meat packing, sugar, wine, and pulp and paper industries, expressed in terms of tons of biological oxygen demand (BOD in english, or DBO in spanish) and population equivalents.

While these data give some indication of the magnitude of oxygen demand associated with releases from these industries, conclusions can not be drawn from these data regarding the resultant degradation in water quality. Water quality degradation resulting from high-BOD wastes is a function of the size, flow rates, and oxygen replenishment rates of the individual water bodies receiving these wastes, and the rate of BOD release to these water bodies. It has been determined, however, that dissolved oxygen levels in some of the water courses receiving these wastes frequently drop to zero (see discussion of Riachuelo and Tucuman Province, below).

Nationwide estimates of industrial releases to the atmosphere are not available. As stated above, industrial impacts on air quality are generally regarded as less important than impacts on water and soil due to the predomination of favorable wind conditions. Significant atmospheric pollution by industry probably occurs in certain localized areas, and in major cities. Atmospheric concentrations of oxides of nitrogen and sulfur and of lead often reach significant levels in Buenos Aires and Cordoba, for example (particularly during the winter months when atmospheric conditions tend to be somewhat more stable), although the relative contribution to this air contamination by industry can not be determined with available data. Significant local atmospheric contamination is thought to occur as a result of emissions from petrochemicals industries in Bahia Blanca and refinery industries in Ensenada, but atmospheric quality in these areas has not been quantified. Air quality degradation resulting from emissions from the sugar and alcohol industries in Tucuman Province are documented below.

3. Types and Quantities of Industrial Pollutant Loadings to the Environment: Two Representative Areas.

Table 1

IMPACTO AMBIENTAL DE LA PRODUCCION DE ALCOHOL.

Demanda a satisfacer	Volumen de alcohol (m^3/año)	Volumen de vinazas (m^3/año)	Carga Orgánica (TnDBO/año)	Población equivalente (hab.)
NOA, NEA Litoral	280/390.000	3.600.000	90.000	4.500.000
NOA, NEA Litoral Córdoba	360/390.000	4.680.000	117.000	5.850.000
Meta Programa Alconafta 1985	1.900.000	22.800.000	570.000	28.500.000
Meta año 2.000	3.300.000	39,500.000	990.000	49.500.000

Source: INCYTH

Table 2

RELACION PRODUCCION/EMISION LIQUIDA DE INDUSTRIA FRIGORIFICA. ARGENTINA

AÑO	PRODUCCION	CARGAS CONTAMINANTES		
	VACUNOS *** (cabezas faenadas)	CAUDAL *** DESECHO $10^3 m^3$/Año	POBLACION ** EQUIVALENTE (habitantes)	CARGA DBO_5 *** (Ton/Año)
1977	14748142	39230.1	2110086	41589.8
1978	16472712	43817.4	2356824	46453.0
1979	15615602	41540.2	2234338	44038.8

Source: INCYTH

Table 3

RELACION PRODUCCION/EMISION DE INDUSTRIA AZUCARERA. ARGENTINA

AÑO	PRODUCCION		CONSUMO AGUA ** (10^3 m^3/Año)	CARGAS CONTAMINANTES		
	CAÑA MOLIDA * (10^3 Ton)	AZUCAR PRODUCIDA* (10^3 Ton)		POBLACION *** EQUIVALENTE (habitantes)	CARGA DBO_5	
					CACHAZA ** (Ton/Año)	EFLUENTE ** LIQUIDO (Ton/Año)
1982	14437	1531	1203	5713293	43311	69298
1986	9601	1038	800	3799493	29803	46085

Source: INCYTH

Table 4

RELACION PRODUCCION/EMISION LIQUIDA DE INDUSTRIA VITIVINICOLA. ARGENTINA

AÑO	PRODUCCION * (Hectolitros)	CONSUMO AGUA ** (10^3 m^3/Año)	CARGAS CONTAMINANTES	
			POBLACION *** EQUIVALENTE (habitantes)	CARGA DBO_5 ** (Ton/Año)
1970	18943387	5835	229274	4519
1974	26189926	8066	316844	6245

Source: INCYTH

Table 5

RELACION PRODUCCION/EMISION LIQUIDA DE INDUSTRIAS DE CELULOSA-PAPEL. ARGENTINA 1990.

PRODUCCION *		CAUDAL DESECHO (10^3 m^3/año)	POBLACION ** EQUIVALENTE (habitantes)	CARGAS CONTAMINANTES TON/AÑO		
PRODUCTOS	CANTIDAD (10^3 Ton/año)			DBO_5 ***	SOLIDOS SUSPENDIDOS ***	SOLIDOS *** DISUELTOS TOTALES
Pulpa Sulfatada (Kraft)	362,768	22238,9	570594	11246,4	6530,2	60222,8
Pulpa Sulfitada	37,908	3133,1	223643	4408,0	881,6	8748,3
Pulpa Semi-Química	194,652	9148,6	266646	5255,6	2433,1	26083,4
Fabricación de Papel	925,945	50001,0	375830	7407,6	21296,7	34260,0

Source: INCYTH

A general indication of the degree of environmental degradation resulting from Argentine industrial activity, and the relative degree of urgency of this issue, can perhaps be best obtained through examination of the situation in two representative areas of the country for which a relatively large amount of data are available: Buenos Aires Province, and Tucuman Province. Although available data for these areas are not comprehensive, they do illustrate the degree of industrial impacts on the environment in these areas.

It should be noted that, because of the regional specialization of industrial activity in Argentina, the particular forms of industry-related environmental impacts discussed for these two areas are not likely to be replicated in other parts of the country. However, the general performance of industry in these two areas with respect to protection of the environment is representative of other industrialized areas in Argentina.

3.1 Buenos Aires Province

Roughly 52% of the industrial establishments in Argentina were located in Buenos Aires Province in 1984 (the most recent year for which regional distribution statistics are available; Gatto et al, 1988). Hence, Buenos Aires Province accounts for a large portion of the industry in the country. Industrialization is not distributed evenly within the province, however. Roughly 80% of all industrial establishments in the province were located in the Buenos Aires metropolitan area (i.e., Greater Buenos Aires, including Buenos Aires City and the immediately surrounding industrialized area; ibid) in this same year. Two other industrialized areas, including Bahia Blanca and La Plata, account for most of the remaining industrial activity in the province.

Data regarding industrial impacts on the environment in the province pertain largely to liquid effluents and surface waters. These data come from various sources; in one case are for the entire province, and in other cases for various geographic subdivisions within the province (including Greater Buenos Aires, Buenos Aires City, the Rio Matanza-Riachuelo river basin, and the Santiago River area). Taken in concert, however, these diverse data provide a good overall picture of the impact of industry on the surface water environment in the province.

Available province-wide data pertain to the oxygen demand associated with contaminants in industrial effluents. Table 6 provides data regarding the total volume of, and oxygen demand (in terms of population equivalents) associated with, industrial liquid effluents in the province, by industry type (SSMA 1981).

Data in Table 6 indicate that the oxygen demand associated with industrial effluents in the province is quite high. As stated above, however, these data provide only an indication of the magnitude of oxygen demand associated with releases from these industries in the province. Conclusions regarding the resultant degradation in water quality can not be drawn

TABLE 6

Estimated Average Industrial Effluent Volume and Oxygen Demand
Buenos Aires Province*

Industry	Average Discharge	
	Volume (m^3/day x 1000)	Population Equivalent (millions)
Food products, drinks, tobacco	2,774	4.45
Paper, chemicals and petrochemicals	623	4.56
Textiles, clothing, tanning	249	1.06
Basic metals, metal products, machinery and equipment	90	3.89

* Estimated based on industrial production data from the 1974 industrial census

Source: SSMA 1981

from these data, since water quality degradation resulting from high-BOD wastes is a function of the size, flow rates, and oxygen replenishment rates of the individual water bodies receiving these wastes, and the rate of BOD release to these water bodies.

Additional data regarding industrial residues in the province pertain specifically to the Greater Buenos Aires metropolitan area. A rough estimate of the amount of solid and hazardous wastes generated annually by industry in the Greater Buenos Aires metropolis was developed in 1980 by the public waste management corporation Coordination Ecologica Area Metropolitana Sociedad del Estado (CEAMSE). This estimate is based on the responses to a questionnaire sent to a select group of industries (information regarding the statistical design, sample group, or response level for this survey are not available; the data must therefore be considered as indicative only). Data from the CEAMSE survey are presented in Table 7 (CEAMSE 1991).

No conclusive information regarding the management of these wastes is available. It is known, however, that many industries: clandestinely dump residues into water courses during periods of heavy rain; contract with domestic waste management companies to haul industrial residues to domestic waste landfills; dump industrial residues into septic tanks intended to hold domestic sewage, or contract with firms that empty septic tanks to haul away industrial residues (interview with Alberto Moran, Subsecretario de Medio Ambiente, Secretatia de Salud y Medio Ambiente, Municipalidad de la Ciudad de Buenos Aires, June 28, 1991). The ultimate result is that industrial residues are not isolated from the environment, and generally end up in sewage systems or surface water bodies.

It is estimated that the sewage system of Buenos Aires City releases 35 cubic meters of effluent per second into the Plata River without treatment. An estimated 70% of this effluent is industrial in origin. This effluent is discharged over a kilometer offshore, and several kilometers downstream of the city center. The Plata River is 30 km wide at Buenos Aires; it is heavily polluted along the Buenos Aires shoreline out to a point three kilometers from shore, due primarily to the industrial and domestic effluent released into the river in the Greater Buenos Aires area (ibid).

Further information regarding industrial impacts on surface waters in Buenos Aires Province pertains to the Rio Matanza-Riachuelo river basin. This river basin covers 2,303 square kilometers, and stretches 64 kilometers in length. The basin lies east-west roughly in the center of the province of Buenos Aires. A large portion of the basin lies within the greater Buenos Aires metropolitan area, and the last several kilometers of the Riachuelo forms the southern boundary of Buenos Aires City. The basin encompasses a section of the most highly populated and heavily industrialized area of the country (Federovisky 1988).

It is estimated that there are approximately 20,000 industrial establishments in the basin. Estimates of the portion of these establishments which have no functioning waste treatment capability range from 63% to 97.5% (estimates derived by two different researchers, using different definitions of functioning waste treatment). The great majority of the

TABLE 7

Estimated Industrial Residue Generation Rates:
Greater Buenos Aires (1980)

Residue type	Generation Rate (tons/yr)
Solids (various)	100,000
Sludges (noncombustible - various)	50,000
Liquids: Aqueous inorganic wastes	120,000
Oil/water mixed wastes	60,000
Solvents	30,000

Source: CEAMSE 1991

pollution in the Matanza River-Riachuelo is attributed to industrial pollution (Federovisky 1988, citing various researchers).

The most important industries in the river basin are food processing industries. Other industries contributing significant pollutant loads include plastic, chemical, and basic metal industries (ibid).

Table 8 presents the results of a chemical and biological examination of the river conducted in April, 1984. These data indicate an extremely high degree of pollution by a number of contaminants at various points in the river basin. Of particular concern are the extremely high concentrations of chromium, lead, and zinc, both dissolved in the water column and combined with river sediment. Concentrations of other contaminants are also very high, while the dissolved oxygen content approaches zero in several sampling locations. Other investigations have found dissolved oxygen concentrations of zero at various points in the river basin (ibid). The dissolved oxygen concentration is commonly found to be zero in the last 7 kilometers of the Riachuelo, before it empties into the Plata River (Interview with Alberto Moran, June 28, 1991).

It is clear from these data that industrial pollutant loadings in the Matanza River-Riachuelo basin cause serious water quality degradation.

A final group of data regarding industrial pollutant loadings to water bodies in Buenos Aires Province pertain to the Santiago River in La Plata. The largest oil refinery in Argentina, processing more than 60% of the crude oil processed nationwide, is located on a canal connected to the Santiago River. Several other industries, including petrochemical, synthetic fiber, and paper industries, are also located along this canal (Catoggio, undated). Table 9 presents data regarding contaminant levels in the effluent of four of these industries (which are not identified in the original report). Table 10 presents contaminant concentration data for water in the Santiago River downstream from a fiber factory and a paper factory.

According to Catoggio (undated report) the west canal of the River Santiago is constantly covered with a layer of hydrocarbons. The dissolved oxygen content is generally too low to support any form of aerobic life. The west canal is estimated to carry 810 kg of aliphatic hydrocarbons and 48 kg of polynuclear aromatic hydrocarbons to the Santiago River every day
(ibid).

3.2 Tucuman Province

Tucuman Province is located in northwestern Argentina. Due to a government policy promoting the location of industries in Tucuman certain areas of the province, particularly San Miguel de Tucuman, are relatively highly industrialized. Most industries are located adjacent to tributaries of the River Sali, or to the Sali itself (Tucuman Province Government, 1991).

CALIDAD DE LAS AGUAS MATANZA-RIACHUELO (ABRIL 1984)

Parámetro	Estación Nº 1 4-4-84 11:00 Hs	Estación Nº 2 4-10-84 11:20 Hs	Estación Nº 3 4-10-84 12:15 Hs	Estación Nº 4 17/4/84 11:30 Hs	Estación Nº 5 25/4/84 12:05 Hs	Estación Nº 6 25/4/84 11:13 Hs	Estación Nº 7 4-4-84 11:40 Hs	Estación Nº 8 26/4/84 10:52 Hs	Observaciones
Temperatura (°C)	16	20	21	18,6	15,9	16,1	15,5	20,2	
PH	8,2	8	8	7,1	7	7,4	8,1	8,7	
S.D. (mg/l)	8	0,6	0,4	0,9	1,1	1,6	5,9	1,1	
C.B. (S/cm)	1500	1900	2600	1500	1400	570	950	1100	
Alcalinidad T.	557	654	664	630	458	167	500	380	NSD no se terminó
Cloruro (mg/l)	26,5	36,9	42,8	19,7	33,5	28,5	24,5	30,5	
Sulfato (mg/l)	415	751	NSD	515	618	244	162	248	
Sulfuro (mg/l)	< 0.025	2,6	< 0.025	3	0,8	1	< 0.0 5	0,5	
Dureza T.	209	260	282	239	257	130	122	190	
Calcio (mg/l)	38,9	46,5	55,3	43,2	55,4	29	29,2	43,2	
Magnesio (mg/l)	27,3	35,1	35,1	33,8	31,14	14,3	11,9	22	
Sodio (mg/l)	322	440	200	440	344	164	267	320	
Potasio (mg/l)	100	36	40	38	23,6	11,2	7,1	22,8	
Cobre S. (mg/g)				460	400			150	S: Sedimento
NTK (mg/l)	3,19	10,9	14,6	24,2	17,3	7,98	6,65	17,8	
N-NH3 (mg/l)	0,68	6,63	7,75	17,2	12,9	4,88	2,05	9,13	
N-(NO3-NO2)(mg/l)	1,8	0,19	0,198	0,257	0,168	0,335	1,71	0,317	
DBO7 (mg/l)	6,4	42	88	81	76	26	6,3	111	
DQO (mg/l)	25	85	200	178	143	108	105	305	
S.Fenólicas (mg/l)	0,017	0,021	0,029	..027	0,101	0,031	0,015	0,04	
A.S.Grasas (mg/l)	3,6	5,7	NSD	4,5	8,5	57	2,5	12	
Detergentes (mg/l)	0,096	0,263	0,141	0,218	0,345	0,218	0,157	0,599	
Ortofosfatos (mg/l)	0,257	0,734	0,43	0,57	0,95	0,46	0,776	0,6	
Colifecales(N/)	< 100	1.4 .10 8	10 . 10 8	5 . 10 9	11 . 10 9	5 . 10 9	10 . 10 8	1.5 . 10 9	
Hierro D. (mg/l)	1,3	0,9	1,25	1,75	2	2,65	0,95	2,4	D: Disuelto
Hierro S. (mg/g)				37000	40000			4000	S: Sedimentado
Cadmio D. (mg/10				0,002	0,003			0,005	
Cadmio S. (mg/g)				< 1	< 1			< 1	
Mercurio D. (mg/l)				...	5			6	
[illegible] (mg/g)				0 025	5			8	
Cromo D. (mg/l)				200	0,09			0,43	
Cromo S. (mg/g)				0,04	120			62	
Plomo D. (mg/l)				1100	0,034			0,034	
Plomo S. (mg/g)				0,1	2000			170	
Zinc D. (mg/l)				1000	0,2			0,5	
Zinc S. (mg/g)				0,02	2800			300	
Cobre D. (mg/l)					< 0.02			0,1	
Turbidez (UNT)	18,5	12,5	10,5	58,9	38,3	2206	10,5	201	
S.S. (mg/l)	11	18	14	42	48	211	13	235	S.S.: Sólido Suspendido

Table 8

Source: Federovisky 1988

Table 9
Concentrations of Organic and Heavy Metal Contaminants in the Effluents of Various Industries Located Along the West Canal (Santiago River)

		Industry A 08/09/88	Industry B 01/08/89	Industry C 08/09/88	Industry D 13/10/88
		Hidrocarburos Alifáticos			
Benceno	mg/l	$7.3x10^{-4}$	$3.6x10^{-3}$	$8.9x10^{-4}$	$2.4x10^{-4}$
Nañaleno	mg/l	vest	$1.0x10^{-3}$	$1.0x10^{-3}$	$1.7x10^{-2}$
Antraceno	mg/l	$5.0x10^{-5}$	$1.8x10^{-3}$	$6.7x10^{-4}$	$4.2x10^{-3}$
Tolueno	mg/l	vest	-	$8.9x10^{-4}$	$2.4x10^{-4}$
Fenantreno	mg/l	$4.0x10^{-4}$	$6.0x10^{-3}$	$9.7x10^{-3}$	$3.8x10^{-3}$
Fluoreno	mg/l	$1.7x10^{-4}$	$4.6x10^{-2}$	$1.3x10^{-2}$	$5.4x10^{-3}$
Fluoranteno	mg/l	$1.6x10^{-3}$	-	$4.6x10^{-3}$	$2.6x10^{-3}$
Pireno	mg/l	$1.2x10^{-3}$	-	$1.5x10^{-3}$	$1.7x10^{-3}$
Criseno	mg/l	$3.3x10^{-3}$	-	$2.3x10^{-3}$	-
		Metales pesados			
Hierro	mg/l	1.60	$3.1x10^{-1}$	1.4	$6.7x10^{-1}$
Cobra	mg/l	$8.0x10^{-2}$	$<2.0x10^{-2}$	$4.0x10^{-2}$	$6.0x10^{-2}$
Manganeso	mg/l	$5.0x10^{-2}$	$3.8x10^{-2}$	$1.2x10^{-1}$	$2.0x10^{-2}$
Cinc	mg/l	$1.3x10^{-1}$	$2.0x10^{-2}$	$3.0x10^{-1}$	$1.8x10^{-1}$
Plomo	ug/l	50.5	126	295	3
Cromo	ug/l	<3	<5	3	3040
Cadmio	ug/l	-	-	-	-

Source: Catoggio

Table 10

Concentration of Contaminants in Water Downstream of Outfalls From a Fiber and a Paper Factory (Santiago River)

Determinación		Fiber Factory	Paper Factory
		01/09/88	01/09/88
pH		6.5	7.5
Turbiedad	NIU	21	185
Sól suspens	ppm	46	5866
Oxig. disuelt	mg/l	2.9	0
DBO^5	mg/l	90	445
DQO	mg/l	165	3015
Sust sol éter	mg/l	42	38
Ag	mg/l	0.13	0.14
Fe	mg/l	1.2	15
Pb	ug/l	5.0	45.5
Cr	ug/l	N/D	58
Cd	ug/l	$<1x10^2$	$<1x10^2$
Bacl coliform	npm%	950	$1.9x10^4$
Bacl colifec	npm%	240	$9.5x10^3$
Cu	mg/l	-	$4x10^{-1}$
Mn	mg/l	-	1.0
Zn	mg/l	-	30

Source: Catoggio

The predominant industries in the province are sugar and alcohol (often combined facilities), paper, citrus products, slaughter house, soft drink bottling, and candy industries (ibid).

Surface Water Impacts. The primary wastes discharged into surface waters (and ultimately affecting water quality in the River Sali) are organic wastes, or biomass. It is estimated that 164,000 tons of organic material are discharged into the Sali river basin each year by industry. Hence, the most significant impact on the surface water environment is excessive oxygen demand and oxygen depletion.

The alcohol industry discharges roughly 68% of these organic wastes. This industry produces some 350 million liters of alcohol per year. For each liter of alcohol produced, 12 to 15 liters of vinaza (fermented molasses residue from which the alcohol has been distilled) are discharged. Thus the Tucuman Province alcohol industry discharges roughly 4.2 billion liters of vinaza each year. The BOD content of this waste is on the order of 58,000 ppm, while the organic solids content is 5.8% by weight. Vinaza wastes also have a high salt content. The predominant anion is potassium; other anions present include calcium and sodium. The predominant anion is sulfur; chlorine is also present.

The use of vinaza wastes for irrigation and fertilization represents a possible alternative to the discharge of these wastes to water courses. Of the 13 distilleries in operation in Tucuman, 3 currently send vinaza wastes to agricultural fields. The remainder of these industries discharge their vinaza wastes directly into surface water bodies. Further research on the use of vinaza in agriculture has been proposed, and funding is being sought. The use of vinaza wastes for irrigation and fertilization is considered the most viable system for environmentally sound management of these wastes. Treatment facilities for vinaza are considered to be prohibitively expensive (ibid).

Another form of waste from the sugar/alcohol industry is cachaza, fine sugar cane solids remaining in the cane juice extracted from the crushed cane. The sugar/alcohol industry in Tucuman Province produces 400,000 tons of cachaza per year. Although it is illegal in Tucuman Province to dispose of this waste in surface water bodies, water channels are used to flush cachaza from processing plants and transport it to the point where it is loaded onto trucks for disposal. A portion of the cachaza waste inevitably escapes in wastewater, and is transported to surface water bodies. Cachaza wastes removed from alcohol/sugar plants in solid form are used as fertilizers and soil amending agents (ibid).

The citrus industry is a rapidly growing industry in Tucuman Province, and produces large volumes of highly polluting effluents. Approximately 1,000 to 1,500 cubic meters of liquid effluents are produced by this industry per day; the BOD content of these wastes is roughly 3,500 ppm (ibid).

The province has promulgated regulations requiring the treatment of citrus wastes. However, the cost of equipment capable of complete treatment of these wastes is extremely high; estimated at over US$ 1 million per plant. Most facilities have installed only primary treatment equipment, which removes some solids and neutralizes the acid content, at a cost of US$200,000-300,000 per plant. Installation of complete treatment systems for these wastes is considered economically infeasible (ibid).

The Tucuman Province paper industry primarily uses sugar cane as its raw material. This industry produces a large volume of highly polluting effluent: approximately 30,700,000 kg/year of organic waste material are discharged by this industry in liquid effluents exhibiting a BOD of around 1200 ppm. These wastes also contain a high level of sodium, and therefore can not be used as irrigation/fertilizer. Equipment for the treatment of paper industry wastes is extremely expensive; its installation is not considered feasible (ibid).

The discharge of the above wastes into the River Sali and its tributaries results in serious degradation of the river water quality. During the period of May through November, which is the period of peak crop harvests and industrial activity and minimal river flows, an 85-kilometer reach of the River Sali exhibits a dissolved oxygen content of 0.

Air Impacts. The sugar/alcohol industries in Tucuman province release an estimated 26,000 tons of particulates, 400 tons of carbon monoxide, 230 tons of hydrocarbons, and 300 tons of nitrogen oxides into the atmosphere each year (ibid).

The primary source of these emissions are the burning of bagasse (crushed cane) for energy; 80% of the industry's energy requirements is met in this way. Additional air pollutants associated with this industry come from the practices of burning the cane fields before harvest, and burning over the residual material left in the fields after harvest.

As a result of these emissions, the rate of atmospheric particulate matter settle-out in some areas of the province reach 60 tons/square km/month. The air quality standard for this parameter is 5 tons/sq. km/month (ibid).

4. Human Health and Environmental Risks Associated with Industrial Pollutant Concentrations in the Ambient Environment.

Epidemiological and ecological studies focussing on the impacts of industrial pollutant loadings in Argentina are not available, and available industrial contaminant release rate and environmental concentration data do not permit a comprehensive assessment of the impacts of industrial pollutant loadings to the environment on human health and the ecology. Given the types of industry present, the types of residues generated, the tendency for geographic concentration of industry, and the frequent lack of pollution control, it is likely that concentrations of industrial contaminants in the ambient environment reach levels which pose threats

to human health and to the ecology, particularly in areas which are in close proximity to industrial facilities or complexes.

Specific examples of situations in which concentrations of industrial contaminants in surface waters exceed levels considered safe for human exposure or aquatic wildlife can be seen in the data presented above for the Matanza River-Riachuelo and for the Santiago river (Tables 8 and 10). These examples provide some indication of the degree of severity of the threat to human health and the environment posed by industrial pollution. In some cases established safe concentration levels for certain contaminants are exceeded by several orders of magnitude.

Table 11 presents two situations in which the concentrations of industrial pollutants in the Matanza River-Riachuelo exceed benchmark human exposure safety levels established under the United States Environmental Protection Agency (USEPA) Superfund program. As the data in Table 11 indicate, the concentrations of chromium and mercury in this river system are several orders of magnitude greater than the levels considered likely to be safe for drinking water exposure.

Several situations are outlined in Section 3 above in which surface water body dissolved oxygen levels approach or reach zero (Riachuelo near its mouth and at points indicated in Table 8; west canal of the Santiago River; River Sali for an 85-km reach downstream of San Miguel de Tucuman). These conditions result in the near-elimination or the elimination of aerobic aquatic wildlife from the affected section of water body, and in extreme degradation of the aquatic ecologies in these affected sections.

Additional adverse effects on aquatic wildlife and ecologies can be expected as a result of the high concentrations of industrial chemical pollutants in the rivers discussed above. Table 12 presents a comparison of industrial pollutant concentrations in two of these rivers to water quality criteria established by USEPA for the protection of aquatic wildlife. As these data indicate, water concentrations of the industrial pollutants included in Table 12 significantly exceed the established criteria in most cases, and exceed these criteria by several orders of magnitude in some cases (notably the concentrations of lead and mercury in the Matanza River-Riachuelo). The presence and concentration of the industrial pollutants presented in Table 12 can be expected to have a deleterious effect on wildlife and the ecology of the rivers in question.

The cases presented in Tables 11 and 12 are limited in number, but serve as examples of a situation likely to exist in many industrial areas (and in the asssociated downstream, downwind, or downgradient environments) in Argentina, in which industrial pollutant concentration levels in the natural environment are sufficient to endanger human health, and cause ecological damage. The potential threat to human health and the environment posed by industrial pollutant loadings in Argentina is therefore believed to be significant.

TABLE 11

Comparison of Industrial Contaminant Concentrations in the Matanza River-RiaChuelo to USEPA Benchmark Concentrations.

Contaminant	USEPA Benchmark Concentration (mg/l)[a]	River Water Concentration (mg/l)[b]
chromium	1.8×10^{-1} [c]	200
mercury	1.1×10^{-2} [c]	8

a. Drinking water benchmark, as defined under the USEPA Superfund program Hazard Ranking System

b. From Table 8

c. Based on: 1) the maximum oral dose considered to pose no appreciable risk of deleterious health effects over a lifetime (oral RfD), and 2) an assumed ingestion rate of 2 liters/day

TABLE 12

Comparison of Industrial Contaminant Concentrations in Two Argentine Rivers to Criteria for the Protection of Aquatic Wildlife

Contaminant	Concentration Criteria Acute Toxicity (mg/l)[a]	Concentration Criteria Chronic Toxicity (mg/l)[b]	River Water Concentration (mg/l)	River[c]
cadmium	3.9×10^{-3}	1.1×10^{-3}	5×10^{-3}	M-R
copper	1.8×10^{-2}	1.2×10^{-2}	1×10^{-1}	M-R
			4×10^{-1}	S
iron	-	1.0	2.6	M-R
			15	S
lead	8.2×10^{-2}	3.2×10^{-3}	1,100	M-R
			4.5×10^{1}	S
mercury	2.4×10^{-3}	1.2×10^{-5}	16	M-R

a. Contaminant concentrations exceeding these criteria have been shown to have acute (i.e. almost immediate) deleterious effects on aquatic wildlife.

b. Contaminant concentrations exceeding these criteria have been shown to have deleterious effects on aquatic wildlife after prolonged (i.e. several weeks) exposure.

c. M-R = Matanza River-Riachuelo (see Table 8); S = Santiago River (see Table 10)

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