JUNTA MUNICIPAL DE AGUA Y SANEAMIENTO

CD. JUAREZ, CHIH.

BECC STEP II FORM

North and South Wastewater Treatment Plants Project

And Supplemental Sewerage Projects

for Cd. Juárez, Chih.

July 1997 Cd. Juárez, Chih.

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1. **EXECUTIVE SUMMARY**

a. General Description of the Projects

The projects have been described as fundamental components to the ***general urban sanitation program for wastewater collection and treatment in Cd. Juárez,*** and are comprised of the following:

- Two wastewater treatment plants, North and South, which will provide Advanced Primary Treatment (APT). This type of treatment allows the effluent to be used for agricultural irrigation purposes.
- Supplemental sanitation projects that will include new conveyance lines for drainage and sewerage lines.
- Supplemental projects that will rehabilitate and replace the sanitary sewerage lines in various sectors of the city.

A summary of all the supplementary projects, including implementation costs, is provided in the General Information section under the Technical Feasibility chapter.

The following description provides a general overview of each of the projects:

North Treatment Plant

This project consists of the treatment of municipal wastewater through an Advanced Primary Treatment (APT). The treatment involves the grit removal, small material removal, and a clarifoculation treatment, followed by a final chlorine disinfection process. This treatment may be modified based on the demand and wastewater quality to a biological treatment process (activated sludge through no nitrate load.) The project is located in the Valle de Juárez (Juarez Valley) in the Environmental Integration Zone, Irrigation District No. 009, in the confluence of the Intercepting Drainpipe & 1 A, in a 23.6 hectare lot. The plant has been designed to treat 57 MGD (2.5 m^3/s).

South Treatment Plant

This project consists of the treatment of municipal wastewater through an Advanced Primary Treatment (APT). The project involves the grit removal, small material removal and a clarifoculation treatment, followed by a final chlorine disinfection process. This treatment may be modified based on the demand and wastewater quality to a biological treatment process (activated sludge through a no nitrate load). The project is located in the Valle de Juárez (Juarez Valley) in the Environmental Integration Zone, Irrigation District No. 009, one kilometer from the discharge drainpipe, in a 23.5 hectare lot. The plant has been designed

to initially treat 22.8 MGD (1.0 m^3/s) and will be able to reach a capacity of 80 MGD (3.5 m^3/s).

Expansion of Sewage Collection System Coverage to Match the Potable Water Supply Coverage

Colonias located in the east, west and central areas of the City, lacking sewage collection services are: El Safari, Morelos, Manuel Valdes, J.M. Morelos, L.D. Colosio, Palo Chino, Médanos, Lázaro Cárdenas, Barrio Nuevo, Del Desierto and Aeropuerto. As for collectors, these include: the left side of the Collector 2-A, Collector Juárez-Porvenir, Collector 2-C, Bolivia and Costa Rica, A. López Mateos and Brasil. A tract of the Insurgentes Collector and the discharge collector are also included.

These actions will increase the provision of sewage collection services from 80 percent to 93 percent coverage and will mean that 100% of the areas covered by the water supply service will have sewage collection service.

b. Compliance with BECC criteria

1. General Information

After analysis of the wastewater treatment alternatives most appropriate for the conditions present in Cd. Juárez, the Advanced Primary Treatment process was determined to offer the best technical, economical and environmental options. Treatment consists of a clarifloculation process with the help of chemical reagents (coagulant and flocculant) and a final disinfection process in a chlorine contact tank.

Design capacity considers any increases in the amount as well as variations in the quality that may be experienced in the influent at both the North and South Wastewater Treatment Plants. The capacity of the North Plant will be 57 MGD (2.5 m^3/s); these results were obtained from influent studies in the sphere of influence. The capacity of the South Plant will be 23 MGD (1.0 m^3/s) during the first stage and will have future capacity to treat 80 MGD (3.5 m^3/s).

Related parallel projects include final installation of 36 miles (57.6 km) of collectors and drainage pipes to convey wastewater to the North and South Wastewater Treatment Plants.

This project also includes the implementation of supplemental sanitation projects. The projects consist of rehabilitating and replacing collectors and 13 miles (21.1

km) of municipal drainage and sewage pipes. The rehabilitation project for the main collectors includes installation of missing lines; at present the project is 88% complete.

2. Human Health and Environment

By treating 100% of the wastewater being generated, the projects will have a significant affect on the sanitation problems experienced in the city. Similarly, 93 percent of the city will have sewer collection, equivalent to the water supply provided. Furthermore, the quality of the treated effluent will exceed norms established by the Official Mexican Norm 001-ECOL/96, which regulates water quality for agricultural irrigation.

Among the problems related to public health and the use of wastewater, which have been identified in the larger communities located in the Valle de Juárez, are gastrointestinal diseases. These communities will experience a noticeable decrease in these diseases. In accordance with the Coordinated State Public Health Services, acute intestinal infections have over the past two years (1995 and 1996), placed second in the incidence of diseases; incidence of respiratory diseases being first.

The supplemental sewage collection projects will address the service needs of the community and ensure that wastewater is treated by the treatment plants and thus avoid direct wastewater discharges into irrigation canals, streams, or naturally occurring water bodies.

The project's environmental assessments have been submitted to the authorities regulating the protection of natural resources. The environmental impact authorizations have been issued for both the North and South Treatment Plants and a statement of no impact on cultural resources has been issued.

Because the supplemental sewage collection projects will be realized in urban areas and not in any of the areas designated as Protected Natural Areas or environmental conservation areas, they will not have any additional adverse environmental impacts. Furthermore, they will not have a negative impact on any cultural or historical area. They will, however, have a positive impact on the quality of life and environment in the projects' sphere of influence.

Transboundary environmental impacts on the United States will be positive by avoiding any potential contamination to the soil as well as to any surface and underground water sources.

3. Technical Feasibility

A detailed analysis of the project's technical feasibility is included in the attachments to the Advanced Primary Treatment for the North and South Wastewater Treatment Plants as well as in the technical files for each of the parallel sewage collection projects which have been submitted to the BECC.

Programs for operation and maintenance for start up operations, safety, emergency, quality control, personnel training, and contamination prevention have also been included.

The project will comply with applicable design norms from the time construction begins. As such, construction will comply with State Construction Regulations and all steel structure construction aspects will comply with the guidelines established by the American Institute of Steel Construction.

4. Financial Feasibility

An economic and profitability feasibility analysis has been attached to this document. 75.5% of the total $29.3 million dollars will be in the form of grants. The federal Mexican agencies and the NADBANK (through US Environmental Protection Agency funds) will make equal grant contributions in the amount of $11.09 million dollars. The remaining funds will be provided by Degremont de México (DM) and the JMAS. See chapter 5 for further information. The table below describes the project cost breakdown:

PROJECT	***Pesos***	***Dollars***
North & South Treatment Plants	$ 178,763,000	$ 22,628,200
Sewage Collection and Drainage	$ 18,616,679	$ 2,356,542
Collectors leading to Plants	$ 34,582,567	$ 4,377,540
TOTAL	**$ 231,962,245**	**$ 29,362,310**

The costs as well as all analyses and financial projections are based on December 1, 1996 prices. Expenditures will be adjusted to the current rate of inflation.

Implementation of a 0.47 peso/m3 increase in rates is being considered by charging for sewage collection through a separately fee. The increase will be distributed to the users with a crossed subsidy analysis in order to have the least possible impact on disadvantaged sectors of the community. The rate increase guarantees the project's financial feasibility. Actions to strengthen the Utility's institutional capacity have also been incorporated.

With regard to project management and institutional development of the JMAS, several programs and actions have been developed by the JMAS. Furthermore, an Institutional Development Plan between the applicant and the NADBank worth $731,000 dollars is being sought; C.N.A. will contribute 42% of the cost and PRODIN will contribute the remaining $427,750 dollars.

5. Community Participation

The Utility Board has implemented a community participation and outreach program in compliance with BECC criteria. The program was for the most part carried out during 1995; other significant communication and outreach activities in the media were also carried out. There were also public presentations and exhibits of the project model.

The Utility Board held public meetings at the University of Texas at El Paso (UTEP) in El Paso Texas, and in Ciudad Juárez on August 4th and 7th, respectively, with the thirty-day prior notice given to the public, at which information regarding the rate impacts on users was presented. The meetings also presented the benefits of the Wastewater Treatment Plants and the supplemental sewerage projects as well as the financial program. The public demonstrated its full acceptance and support of the project.

6. Sustainable Development

The Utility Board is an autonomous entity having legal capacity and resources and is decentralized from the Central State Water Board (Junta Central de Aguas Estatal). The Utility Board has the technical and human capacity to ensure the entire Cd. Juárez sewerage program. The sustainability of the proposed sewerage projects is based directly on the environmental and socio-economic benefits that will be obtained. These benefits are described in the technical and financial feasibility sections. As such, the projects are sustainable and furthermore, promote the socio-economic and environmental development without compromising the area's natural resources or needs of present or future generations.

c. List of Documents Submitted to the BECC

The table below lists all documents and information related to the projects, including dates, which have been submitted to the BECC by the JMAS. The information and documents was submitted during the course of work meetings and in accordance with progress made during each project stage.

Documentation	Date
Permit granted by the State's General Office for Urban Development and Environment *(Dirección General de* Desarrollo Urbano y Ecología del Estado)	June1995
Analysis of Environmental Risks	August1995
Technical, Economic, and Financial Feasibility Studies for the Potable Water and Sewerage Services Improvements of Cd. Juárez, Chih.	March 1997
Preventive Report-Environmental Impact Statement (EIS) for the North WWTP	March 1995
Preventive Report-Environmental Impact Statement (EIS) for the South Wastewater Treatment Plant	March 1995
Technical Documents for the North and South plants. Project Description, Financial Report Estimates and Technical Contract Attachments (bid documents	May 1995
Project plants for North and South Plants	May 1995
Presentation of the Wastewater Treatment Plants of Cd. Juárez, Degremont	
Contract Agreement between J.M.A.S. and Degremont includes technical and financial attachments.	June 1994
Technical, Marketing, and Financial Report on the Advanced Primary Treatment (APT) for the North and South Plants, includes general plans and process descriptions.	December 1996
Profitability analysis for the Cd. Juárez Wastewater Treatment Plants prepared by the Deputy Directorate Financial Engineering and Sector Projects Departments (Dir. Adjunta de Ingeniería Financiera y Proyectos Sectoriales). (update)	May 1997
Historical and projected financial information of the J.M.A.S. includes rate decrees for 1996 y 1997 and financial test runs	February 1997
Data on potable water consumption and demand	February 1997
Supplemental information document on Environmental Impacts and Transboundary Impacts (J.M.A.S.)	July 1997
Notice No. LAE 01069/97 EXP 3633/3605 issued by the Mexican Section of the International Boundary and Water Commission.	June 10, 1997
Authorization for the WWTP by the National Water Commission (C.N.A.)	April 7, 1997
Official Notice issued by the General Office for Urban Development and Environment granting authorization to the project regarding environmental impacts	May 14, 1997
Official notice issued by the National Institute of Anthropology and History, (I.N.A.H.) Chihuahua Division, providing notice of no impact on cultural resources	June 3, 1997

19 (nineteen) technical files regarding the Supplemental Sewerage and Drainage projects, a file regarding Laboratory conformance, and a file regarding the purchase of settling equipment for the Sewerage System of Cd. Juárez.	July 1997
Plan of the primary sewerage infrastructure system and supplemental project planning documents	July 1997
J.M.A.S. Discharge Control Program Files. Files regarding sewerage system pipe conditions.	July 1997

2.- GENERAL PROJECT INFORMATION

a. Type of Project

The name of the project is *Construction of North and South Wastewater Treatment Plants and Supplemental Municipal Sewerage Works*. All aspects of the project and work involved has been classified as an environmental priority for wastewater treatment in the Cd. Juárez, Chihuahua border region. A detailed description of the projects is included in Section 3 herein.

b. Project Location

Construction of the plants will be on lots located in the area known as the Environmental Integration zone (*Integración Ecológica*) situated in the Valley of Juárez Irrigation District 009, and located to the east of Ciudad Juárez. Location of both treatment plants is shown in the following table. See location map, Attachment 1.

	Location	**Coordinates**	**Surface Area**
North Plant	Irrigation District 009, Valley of Juárez, Municipality of Juárez	31° 42' 31" N. Latitude and 106° 22' 17" W. Longitude	236,600 (agricultural land use)
South Plant	Irrigation District 009, Valley of Juárez, Municipality of Juárez	31° 39' 14" N. Latitude and 106° 20' 24" W. Longitude	235,000 (agricultural land use)

Table 1.A Project Location

Supplemental sewerage works are located within the city limits of Cd. Juárez in residential and mixed zones. They consist primarily in new systems & rehabilitation for different areas in the city that currently lack services. They also include replacing damages pipes and concluding work on collectors that will convey wastewater to the Treatment Plants. See attached technical files for exact project location.

c. Project Description and Work Tasks

1. Project Description

The project is an environmental sanitation project for treatment of urban wastewater and consists of the construction of two Wastewater Treatment Plants (WWTP) for Ciudad Juárez, Chihuahua.

Initially, treatment of wastewater with a secondary treatment system (activated sludge) in the North and South zones - East of Cd. Juárez - for agricultural reclamation purposes was considered. Presently, the concept under consideration provides Advanced Primary Treatment and offers the best technical, economical, and environmental option and does not hinder the quality of water for irrigation. Treatment consists of a clariflocculation process with the help of chemical reagents (coagulant and flocculant) and a final disinfection process in a chlorine contact tank.

The conveyance drains to the North Plant are the 1-A, 1-C, and intercepting drain. The capacity of the North Plant has been designed to treat 57 MGD (2.5 m^3/s); these results were obtained from influent studies in the sphere of influence.

The Panamericano Sur, Aeropouerto, Lote Bravo, Granjero, Torres del PRI, and 2 "A" collectors will convey wastewater to the South Plant. During the first stage, the South Plant's capacity will be 23 MGD (1.0 m^3/s). Once the project is complete it will reach a capacity of 80 MGD (3.5 m^3/s) due to the southern area of the city experiencing the largest increase in urban growth.

The proposed supplemental sewerage projects, part of the comprehensive sanitation project, consist in providing services to new areas, laying pipes for the drains, and replacing any collectors in damaged conditions. This last portion of the work will significantly improve the City's current sewerage system and satisfy the need to raise service efficiency levels.

Based on results obtained in a 1995 J.M.A.S. report on the condition of the Sewerage System, these actions were classified as priority actions. The study's results determined that 64 percent of the system was in good to fair conditions; while the remaining 36 percent was determined to require corrective measures. These measures were proposed under the study's conclusions. For more details, see the reference study carried out by J.M.A.S. in March 1995, and is attached to this document.

2. Project Tasks Program

Project tasks under the new APT process are described in the Advanced Primary Treatment document by Degrement of México and in the Activities Development Plans submitted to the BECC. The principal work tasks are described below:

- Construction of collectors to convey wastewater to the North and South Wastewater Treatment Plants. As a supplemental work project, to date the JMAS has 88 percent (34.5 km) of pipes laid, of a total of 39km. in drains, fitted with concrete pipes ranging in diameter between 76 cm. To 2.44 meters.
- Clearing and preparing lots. The lots are level and require little if any leveling and clearing (agricultural fields). This task involves the outline work, leveling, and situating the structures, tanks, facilities, and roads.
- J.M.A.S. has incorporated the construction of temporary power sub stations and the laying power lines to feed construction and operation stages. Furthermore, initial construction stages will rely on a radio and telephone communication system.
- Construction of potable water lines. J.M.A.S. has constructed 2.5 km. in water lines for the South Plant and 700 meters for the North Plant. The water lines are 3" steel pipes.
- Construction of treatment infrastructure. Degremont of México has programmed installing a plant to supply concrete to the sites. Construction of roads will consist in a cemented gravel base and sub base followed by a layer of asphalt. It includes drainage systems, storm water collectors, curbs, and manholes.
- Start Up Operations. Once start-up operations begin, the effluent quality monitoring program will also commence. This program will be in place both before and during operations of the North and South WWTP; program guidelines are currently being developed by the C.N.A., J.M.A.S., and the Mexican Section of the I.B.W.C. and will be submitted to the BECC.
- Water Culture Program. This program is also in developmental stages and not only includes user and community awareness action plans but also integrates government and public participation in the regional sanitation program's actions and progress.
- Installation of 52 km. in new concrete and PVC pipes and 8.4 km. of collectors in Colonias classified as priority areas by the City.

The parallel sanitation projects are part of the strategic planning program to provide potable water and sewerage services during the second phase of the Master Plan for Cd. Juárez.

The following time-table illustrates the planning stages to carry out comprehensively all work for the North and South WWTP as well as the supplemental drainage system works. It must be noted that implementation of the new sewerage system projects are subject to the public works authorization to be issued by the City for the replacement of pipes in damaged condition, therefore, the time-table is tentative:

	1997				1998												1999	
Project	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VII	IX	X	XI	XII	I	II
North WWTP	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
South WWTP				X	X	X	X	X	X	X	X	X	X	X	X	X	X	
New Sewerage Project					X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sewerage Replacement Project			X	X	X	X	X	X	X	X								
Installation of Collectors			X	X	X	X	X	X	X	X								

Source: Studies and Projects Section, J.M.A.S./1997

3.- Description of Community

Information regarding the manner in which the project will influence the community as well information related to the current and projected social and economic conditions has bee included in the Social Profitability for the Community section in the Economic Financial Study of the WWTP. This study, already submitted to the BECC, was prepared by Banobras-Finfra and has been updated by the Deputy Directorate of Financial Engineering and Sector Projects Divisions under the Corporate Financing Section.

4.- Project Alternatives

The proposal since project inception has been the construction of two plants, taking into consideration among other factors, the location of the existing drains and collectors, growth in population tending to be in the South, as well as an improved management and operation of two modular plants, instead of one. The plants also have the capacity to be expanded based on treatment needs and growth in the city.

Project alternatives evaluated range from treatment via filters, settling ponds, activated sludge systems, and included tertiary treatment. However, given the adverse economic conditions and the improvement in wastewater quality obtained via inspection and monitoring activities, and the pretreatment programs for industry and commerce, all of which were implemented by the Utility Board,

it was determined that the ATP efficiently complies with the Specific Discharge Conditions established in environmental regulations in effect.

The treatment plants project was started in 1992. Basic Engineering studies were carried out by the National Water Commission; at that time the Commission established the quality parameters for the effluent to be used for irrigation of agricultural fields in the Valle de Juárez Irrigation District No. 009. Studies concluded that same year. As part of the Basic Engineering study, location alternative for one plant and for two, were carried out. The study also included treatment options for the wastewater.

Detailed information is included in the "Supplemental Information on Environmental Impacts of the WWTP of Cd. Juárez, JMAS 1997", submitted to BECC.

With regard to the project alternatives for the supplemental sewerage works, see attachment regarding conditions of the sewerage system pipes, JMAS/1995.

5.- Project Justification

The project is well justified from the standpoint that it will improve both environmental sanitation as well as the quality of life of the population served. It will provide benefits through the construction of the supplemental works, installation of collectors, and construction and replacement of drainage lines as well as the treatment and reclamation of wastewater. Furthermore, important factors to consider include public health statistics that indicate that the larger communities in the Valle de Juárez suffer from a high rate of gastrointestinal diseases.

In addition, the need to materialize the project is justified in the Master Plan for Potable Water and Sewerage Services of Cd. Juárez (Technical and Financial Feasibility and Institutional Study regarding the Potable Water, Sewerage and Drainage Systems of Cd. Juárez/1992). This Plan conforms to policies for development under the current Director Plan for Municipal Urban Development. The strategies for balanced growth, outlined in the plan, propose to improve the quality of life in a sustainable manner. As such, the Director Plan also states that all urban sanitation measures must focus on the appropriate collection, transport, and final disposal of municipal solid waste, the expansion of the sewerage system, and the improvement/replacement of the existing system, as well as the treatment and reclamation of wastewater.

d. Conformance to International Treaties and Agreements

Mexico and the United States are working cooperatively, both formally and informally, to improve environmental protection and conservation of natural resources along their shared border.

In 1983, both Governments signed the Agreement for the Protection and Improvement of the Environment of the Border Region between the United States and México (the La Paz Agreement). The La Paz Agreement establishes the regulatory basis for cooperative efforts and also established the 100 km. region on both sides of the border as the border zone of influence.

The Cd. Juárez WWTP project falls within this border zone of influence and is the first of its kind for treating wastewater both locally and regionally.

Agenda 21was one of the results of the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992. The Agenda defines a series of international environmental objectives by providing general guidelines for sustainable development. Agenda 21 encourages communities and their local, state, and federal governments to establish specific programs that will promote sustainable development. In this regard, the Cd. Juárez wastewater treatment project conforms to the proposal developed by the potable water, sewerage and drainage utility board, as it aims to achieve regional sustainable development.

Since its creation in March 1889, and more importantly since its consolidation as a bilateral organization under the Treaty for Water Distribution of February 1944, the International Boundary and Water Commission (IBWC), has carried out significant efforts related to the coordination, consultation, administration, and operation and maintenance of binational infrastructure and sanitation projects along the border. These efforts have made a noticeable and remarkable contribution in addressing the problems and satisfying the needs of border communities.

The IBWC strongly supports the construction and operation of the WWTP for Cd. Juárez and has demonstrated its support in diverse forums held between the IBWC, the State and Municipal Governments, and the J.M.A.S. Their efforts are reflected in the Meeting Minutes of the IBWC, such as Minute 294, "Project Consolidation Program to Address Border Sanitation Problems" and minute 261 "Recommendations to Address Border Sanitation Problems." (See Attachment 2.)

On June 10, 1997, via notice No. LAEO1069/97 EXP: 3633/3605 (Attachment 2 bis). Establishes that both section of the IBWC express their agreement to the project, consider it a positive project, and also state a series of proposed actions

to be undertaken by the IBWC. These actions are to be carried out by the J.M.A.S. and the C.N.A. under their legal authority and will support conformance with the project's sustainability goals. In this regard, J.M.A.S. has stated its willingness to incorporate applicable control measures pursuant to its jurisdiction and also lend support in all measures to comply with national regulations related to national waters whether at the state or federal government level (see Attachment 2, Official Notice No. OFP-091/97).

As such, the Program to be developed by the three agencies (C.N.A., CILA, and J.M.A.S.) is currently in stages of development. The Program will incorporate the following terms of reference:

- Program to systematically oversee the effluent characteristics as well as discharges into the Rio Grande River.
- Monthly reports to the C.I.L.A., through the Mexican section, describing the results obtained from monitoring quality of the effluent being treated by the WWTP.

3. HUMAN HEALTH AND ENVIRONMENT

a) Human Health and Environmental Needs

Currently in the Valley of Juárez, located in Irrigation District 009, 15,450 hectares are being irrigated with wastewater from Cd. Juárez without any prior treatment and other sources resulting from the international treaty and water obtained from agricultural wells. The quality of the combined waters is inappropriate for irrigation due to the negative impact caused on human health and the environment of the region.

In accordance with historical data and information provided by the Sanitation Jurisdiction II, under the Coordinated Public Health Services of the State (S.C.S.P.), in the towns of Gudadalupe D.B. and Praxedis G. Gro. (which have three medical treatment facilities) have a high incidence of acute intestinal diseases. These diseases place second after the number of cases reporting respiratory diseases during 1995 and 1996 as described in the following tables:

MORBIDITY RATES IN GUADALUPE D.B. DURING 1995 Y 1996

BASE POPULATION (1995) 9,253

BASE POPULATION (1996) 10,632

Place	Diagnosis	Cases 1995	Cases 1996	Rate 1995	Rate 1996
1	Respiratory Infections	229	210	2474.8	1975.16
2	Acute Intestinal Infections	50	47	540.36	442.06

Source: Sanitation Jurisdiction II, S.C.S.P. Cd. Juárez, Chih.

MORBIDITY RATES IN PRAXEDIS G. GRO. DURANTE 1995 Y 1996

BASE POPULATION (1995) 8,871

BASE POPULATION (1996) 9,915

Place	Diagnosis	Cases 1995	Cases 1996	Rate 1995	Rate 1996
1	Respiratory Infections	268	501	3021.07	5052.95
2	Acute Intestinal Infections	86	152	969.45	1533.03

Source: Sanitation Jurisdiction II, S.C.S.P. Cd. Juárez, Chih.

The incidence rate has been estimated based on a population of 100,000 inhabitants. The incidence of acute intestinal tract infections during the two year period was steady in Guadalup D.B., while in Praxedis G. Gro., it experienced an increase between 1995 and 1996 by almost 90 percent. This can be attributed to more treatment being provided for these types of cases, however it can also be related to the use of wastewater for agricultural irrigation, which may have caused effects down river by discharging waters both in Cd. Juárez as well as in Guadalupe D.B.. Other sources along the collector and main drain may be a contributing factor.

Furthermore, the supplemental sewerage and collector installation projects will significantly reduce the risks and problems caused by contact with wastewater in those suburbs that lack service. Risks will be entirely removed when existing damaged pipes are replaced. In addition, the problem caused by wastewater must be addressed. Wastewater leaks into the sub surface water sources and contamination is also caused by run off from the sewerage system.

b) Environmental Assessment

1. Conformance with Environmental Evaluation

Project requirements include the submittal of the environmental evaluation to the corresponding authority (the State D.G.D.D.U.E.). As such, the Environmental

Impact Statement (EIS) under a ***General Statement*** has been developed for the construction of the North and South Wastewater Treatment Plants. The project will provide a secondary treatment process based on an activated sludge process.

Currently, the proposed advanced primary treatment process does not have any additional adverse impacts on the ecosystem or the environment during the preparation and construction stages. The State D.G.D.D.U.E. has conditionally approved the APT and is described in the attached document, which includes the supplemental information to the EIS, prepared by the JMAS and submitted to the BECC. The operations section describes additional environmental impacts and recommended mitigation measures. (See supplemental information to the EIS for the North and South WWTP, J.M.A.S., June 1997). The attachment describes the level of current conformance to the new conditions established by the State D.G.D.D.U.E.. These are based on the authorization granted for the APT project.

As part of the conformance with the conditions established by the state environmental impact authorities, the Environmental Risks Study was prepared as Risk Analysis for the North and South Plants. This document was submitted to the state D.G.D.D.U.E. this year, a copy of which was also submitted to the BECC.

In this regard, the J.M.A.S. is developing an Update to the Risk Analysis for the North and South Plants in conformance to the Advanced Primary Treatment Process. The corresponding permit is also being requested from the federal environmental agency. This analysis should be concluded during the second week in September 1997, and the corresponding permit is expected to be issued by the last week in October 1997.

With regard to the supplemental sewerage works, submittal of an Environmental Impact Statement is not required for municipal wastewater conveyance systems. In this case, analysis of environmental effects caused by these works shows that direct positive impacts are greater than any possible effects on the resources or environment.

It must be noted that the North and South Wastewater Treatment Plants Project has been designed with a capacity to treat wastewater generated in the Felipe Angeles Suburb as well as wastewater generated in the Northern area of the city. It has also incorporated future projections for the WWTP. As such, the project will have the capacity to provide service to these areas with the supplemental sewerage works.

2. Description and Analysis of Environmental Effects

A brief description has been provided for the major environmental impacts since greater detail has been provided in the supplemental document as well as in Chapter V (identification, evaluation and description of Environmental Impacts) of the EIS for the North and South WWTP. This information is valid and applicable pursuant to the evaluation done by the State D.G.D.D.U.E.. For more detailed information, please refer to the documents submitted to the BECC.

As stated above, the North and South Wastewater Treatment Plants project will have positive impacts, going from no treatment whatsoever to a treatment level that exceeds Mexican regulations. However, adverse impacts will be generated during construction and operation phases of the project. For the most part these impacts can be mitigated and as such several prevention and control measures have already been defined.

As such, these negative impacts require application of specific preventive and/or mitigation actions. The EIA supplemental information recommends establishing measures to address the following principal effects:

- Dispersion of construction material and waste contamination into the surrounding areas/lots and along the access roads (includes particle emissions into the atmosphere).
- Generation of residual sludge (will be dehydrated and deactivated with caustic lime and then disposed in the Municipal Landill).
- Effects on the quality of Rio Grande River (A substantial improvement with the advanced primary treatment of wastewater will be obtained via the natural elimination of contaminants. See preliminary self-purification process study which was carried out at the conduction drains and up to the point where the effluent is discharged into the river. In addition, a joint monitoring program on the amount and quality of the treated effluent, in order to established preventive and corrective measures required has been proposed)
- Establishment of low water irrigation periods for agricultural activities (a permanent monitoring program to check quality of treated effluent and an outreach and awareness program for the farmers in the region have been proposed.)
- Risk of chlorine gas leaks (programs to prevent and control leaks, contingency plans, training programs for chemical compound handling, and emergency response plans will be implemented.)

Dispersion of construction materials and contamination into surrounding lots/areas and along the access road will be common during construction of the plant. Continuous transport of material such as, sand, gravel, cement, beams, etc.,

inevitably results in small, but continuous leaking of material. This has been classified as a polluting activity and can feasibly be decreased or avoided if EIA recommendations are followed.

With regard to any dispersion by wind related to the placement/location and storage of construction materials, such as sand, covering the material with canvas, plastic, cardboard, or other material will be required to avoid dispersion.

In order to transport sludge produced by the treatment plant, use of a special vehicle to transport the waste should be included as part of the project's operation. The sludge will be dehydrated and stabilized with lime. Nonetheless, the vehicle must have a special bed to collect or prevent leaking. As a preventive measure, the most direct route possible should be considered for sludge transport, avoiding as much as possible, transporting sludge through residential areas.

With regard to any potential effects on the quality of the Rio Grande River water, it must be noted that at present, all wastewater generated in Cd. Juárez, mixed with water from agriculture wells and with river water, in accordance with the International treaty, are being utilized for agricultural irrigation. Only in certain cases, is the wastewater discharged into the Rio Grande River. Especially during the months of November and March (no irrigation period) will these effects be considerably reduced once the North and South WWTP starts its operations and after the go from not being treated whatsoever, to a substantially better treatment process. Furthermore, through the natural self purification treatment of the effluent, an additional improvement in the quality of the water will be obtained (See attachment 5, Preliminary Self-Purification Study, J.M.A.S.-BECC/1997).

With regard to the development of agriculture practices requiring low levels of water for irrigation, once improved sanitation conditions are reached and recommended user awareness programs regarding the amount of water that will be available and the crop type to be planted, will these programs become feasible. As such, these programs will be developed jointly by the C.N.A. and the J.M.A.S.

3.- Transboundary Environmental Impacts

A detailed description of the transboundary environmental impacts has been included in the Supplemental Information to the EIS for the North and South Wastewater Treatment Plants, J.M.A.S., June 1997. The description basically covers the following aspects:

- Effects caused by domestic discharges into the Rio Grande
- Effects on quality of underground water resources
- Effects on water quality of the Rio Grande River

With regard to the domestic discharges that are not conveyed through the municipal drainage and sewerage system and may reach the Rio Grande, a more extensive analysis can be found in the attached Supplemental Information Report to the EIS. This report also states that the J.M.A.S. does provide coverage to the are in question (Suburb Felipe Angeles); coverage includes part of the tract between the border and the international damn. These two are a product of different causes, among them, basically the hydraulic and survey design (water plugs and leaks, puddles of storm water discharges, etc.)

Nonetheless, the J.M.A.S. intends to provide this service to the residential areas lacking service once all legal ownership of land has been settled (in cases of disputes) and through a sewerage program for those areas that lack service. For this particular area, 3,230 meters in pipes are required to reach 100% coverage (See attached document ISIA, JMAS/97).

This situation causes seasonal discharges into the River in this area. Natural runoff occurs with the rainwater and accumulation is caused by the topography. They are then discharged through the metal gates built specifically for this purpose. Location of the gates is described in the attached location map included in the Supplemental Information to the EIS, JMAS/1997).

With regard to underground water resources (and quality), there are two aquifers in the region, one is sub surface while the other is deep underground. The sub surface aquifer in the study area varies between 2 to 20 meters in depth and is considered to be vulnerable to contamination caused by leaking. The is based on the preliminary studies of vulnerability rates to the aquifer system of Cd. Juárez, prepared by the Geo-Hydrology Department of the JMAS, June 1997. The study describes the sub-surface aquifer's area of influence and the existence of two recharge sources. The first source is the contributions by the Rio Grande River and the second source is the agricultural irrigation in the Valle de Juárez. The second source is important since irrigation is done with a mixture of water coming from wells, the international treaty, and wastewater. This poses a contamination risk to the sub surface aquifer because it includes poor quality water. Once the WWTP is in operations, the impact will be considerably reduced.

With regard to the effects on the water quality of the Rio Grande River, it must be noted that part of the wastewater generated in Cd. Juárez is discharged into the Rio Grande River downstream from the main discharge canal. Included is wastewater that has not been utilized by Irrigation District 009 after having flowed through the entire canal and collector system. Once operation of the Treatment Plants commences, this source of contamination shall be reduced.

However, excess treated effluent not utilized in agriculture will be eventually discharged into the Rio Grande River. At this point, the quality of the effluent will have been self-purified after it flows a total distance of 120 km during a two day period. (See Preliminary Evaluation of Self- Purification of the Effluent of the North and South WWTP, Attachment 5). It must be noted that the treatment plants are per se a mitigation measure in support of sanitation efforts of the Rio Grande River. The plants' impacts are positive in that the wastewater will go from absolutely no treatment whatsoever to complete treatment.

The quality of the treated effluent, according to the Mass Balance, is for BOD5, 95 mg/l and for TSS, 27 mg/l. These standards undergo a natural self-purification process as the effluent travels 120 km, from the point of discharge located next to both plants to the point of discharge into the Rio Grande River.

Based on the Preliminary Evaluation of Self-Purification Process of the Effluent of the North and South Wastewater Treatment Plants, the following BOD values were obtained at the discharge point:

Location	**TEMPERATURE**		
	14 C	**24 C**	**29 C**
BOD_5 effluent WWTP (mg/l)	95	95	95
BOD_5 Km 120 Fort Quitman(mg/l)	***74.1***	***68.9***	***61.7***
BOD final (mg/l)	107.3	100.8	90.2

Notwithstanding the discharge standards, these values will increase to an average 65 mg/l of BOD_5. Furthermore, though the Mexican standard is 120 mg/l, the plants will produce an effluent of 95 and eventually will be 65 mg/l.

Water quality standards in the United States are stricter than Official Mexican Norm 001-ECOL-1996, and as such, treated water quality will be closer to the stricter U.S. norm. This will provide a direct positive environmental impact and will also provide higher levels to protect public health and the environment.

The JMAS is planning to carry out a complete self-purification study of the effluent based on the guide included in the preliminary evaluation. Furthermore, if funding from the U.S. Environmental Protection Agency is obtained, the JMAS expects to develop more sewerage and drainage infrastructure and supplemental works in areas requiring service as well as any actions recommended by the Mexican section of International Boundary and Water Commission.

No transboundary impacts generated by the supplemental sewerage works have been identified in the urban area since the nature of the works lend themselves to

providing benefits which include an increase in service coverage from 80% to 93%. This increase will make services compatible with the potable water supply services currently being provided. This situation is very important in that no similar measure has ever been taken in the city.

c. Conformance with Applicable Environmental and Cultural Resource Laws and Regulations

Pursuant to the provisions in the Environmental Law of the State of Chihuahua and Articles 30 and 31, with regard to Environmental Impacts:

The project complies with requirements established in said ordinance. Construction permits regarding Environmental Impacts for construction of the North and South WWTP, DG-0621//95 and DG-0632/95, were issued on June 15, 1995 by the State General Office of Urban Development and Environment, (D.G.D.D.U.E.). (See Attachment 3 and 4). These permits were granted with 19 conditions for construction and operation of the two wastewater treatment plants utilizing a secondary treatment process (activated sludge). Though the treatment proposed initially has been modified, confirmation of issuance of the Environmental Impact permit has been provided by the D.G.D.D.U.E..

This confirmation was issued when all nine treatment conditions were presented (Advanced Primary Treatment). The Environmental Offices of the D.G.D.D.U.E. of the State issued the permit through document No. 0423/97/ dated May 14, 1997. The permit allows development of the construction projects of the North and South WWTP, with an APT process and also established that no additional environmental impact statement is required (See Attachment 6 bis). Furthermore, a series of conditions have been included and will be met to comply with all regulations. The following is a brief description of the situation:

Condition No. 3 (Document 0423/97, D.G.D.D.U.E)

a. Required construction material shall be provided by local companies. Once project begins, Degremont shall be responsible for submitting the information requested.

b. The SEMARNAP authorization for temporary storage, management, and final disposal of hazardous waste during all stages of the project is being prepared by Degremont. Since operations have not yet started, disposal of waste in a specially controlled and registered confinement is being considered.

c. A significant part of the equipment to be used is registered trademark by Degremont (aerators, Desadeg, etc.). There will be other registered trademark equipment and as such all design components and preventive and corrective maintenance programs for the equipment has been obtained.

d. The proposed personnel training program for employees of the North and South WWTP is currently being developed by Degremont; it will be submitted by Degremont upon completion.

The D.G.D.D.U.E. Resolution dated May 14, 1997, describes 18 conditions in addition to the one just described. Conformance, implementation, and follow up to the conditions will be coordinated among the agencies involved and the company responsible for construction and operation of the WWTP (Degremont de México, S.A. de C.V.). Degremont also has the responsibility of carrying out all activities required for the project to comply with design parameters as well as with referenced permit requirements. As such, guarantees will be made to ensure the project complies with all permits and thus avoid all prohibited actions described in the referenced permit and also to ensure conformance with applicable Official Mexican Norms.

- Project will comply with the **Official Mexican Norm** NOM-001-ECOL-96 which established the maximum allowable limits for contaminants in wastewater discharges. The project fall under the category, "For Agricultural Irrigation" under the column "Rivers" in Table 2, of said Norm.
- Project complies with standard values established by the National Water Commission, **CNA**, under the Concession Title No. 2CHH100312/24 HMSG94, related to the specific conditions for wastewater discharges.

With regard to the development and authorization of the **Risk Assessment**, required to comply with environmental regulations, the initial environmental evaluation included development of the Risk Assessment which was submitted to the State D.G.D.D.U.E. in June 1997.

Nonetheless, J.M.A.S. acknowledges that a fundamental aspect of the environmental evaluation includes an updated Environmental Risk Assessment for the new treatment process for the North and South WWTP, and as such, said study is currently being developed and will be concluded by the first week of September 1997. The updated report will request and obtain corresponding permits from the federal environmental agency and it is hoped that it will be issued by the third week of September.

The **National Water Commission** (C.N.A.) has issued official document No. BOO.3.4.087, dated February 20, 1997. This document establishes review and approval of the project, and reports on conformance with applicable Mexican norms. Furthermore, document No. BOO.3.4.221 dated April 7, 1997, approved all management of sludge generated by the plants. Official document DGSP/DL/651/95 issued by the **Municipal Government** of Cd. Juarez, authorized final sludge disposal in the municipal landfill.

With regard to conformance with Cultural Resource regulations, the Statement of No Significant Impact on Archeological Resources at the construction site of the North WWTP was issued by the National Institute of Anthropology and History, Chihuahua Division, via document No. 162-D, dated June 3, 1997 (See Attachment No. 7 and 7 bis). The same statement was issued for the South WWTP.

The following tables summarized all environmental and cultural resource permits issued:

Date Issued	**Permits**	**Issuing Agency**
		State General Offices for Urban Development and Environment (D.G.D.D.U.E.)
June 15, 1995	DG-0621/95 and DG-0632/95 Preventive Report-Environmental Impact Statement in general format for the North WWTP.	**Contact:** Ing. José Treviño Fdez. Dir. Of Environmental Dept.
		Tel. (14) 15 49 37 , 16 64 40
		State D.G.D.D.U.E.
June 15, 1995	DG-0621/95 and DG-0632/95 Preventive Report-Environmental Impact Statement in general format for the South WWTP.	**Contact:** Ing. José Treviño
		Fdez. Director of Environmental Dept.
		(14) 15 49 37 , 16 64 40
		State D.G.D.D.U.E.
August 1995	Environmental Risk Analysis	**Contact:** Ing. José Treviño
		Fdez. Director of Environmental Dept.
		Tel. (14) 15 49 37 , 16 64 40
	Project Review Approval:	National Water Commission, Construction and Potable Water and Sanitation Division
February 20, 1997	Official Documents:	**Contact:** Ing. Jesús Campos López.
April 7, 1997.	BOO.3.4.-087	Tel. (5) 5 24 69 85, 5 34 46 50
	BOO.3.4.-221	Municipal Public Services Division, Maintenance Dept.
	Document issued by the Municipal Govt.	**Contacto:** Ing. Arturo Pérez Reyes.
	DGSP/DL/651/95	Tel. (16) 13 63 63
	Authorization for sludge disposal	

		State D.G.D.D.U.E. **Contact:** Ing. José Treviño
May 14, 1997	0423/97 for Advanced Primary Treatment APT.	Fdez. Director of Environmental Dept. Tel. (14) 15 49 37 , 16 64 40
June 3, 1997	162-D Non existence of archeological artifacts in the areas.	National Institure for Anthropology and History (I.N.A.H.) Chihuahua Division. **Contact:** Antrop. José Luis Peréa González. Director of INAH, Chih. Tel. (14) 16 30 98 , 10 39 48

4.- TECHNICAL FEASIBILITY

a. Appropriate Technology

The search for the best technical and economic option to fully comply with applicable effluent quality regulations (NOM-001-ECOL-1996), in conjunction with the best investment option, has led us to believe that the best solution for treatment of wastewater produced in Cd. Juárez, is an Advanced Primary Treatment (APT). The treatment consists mainly of a clariflocculation process (coagulation + flocculation + primary clarification of the pre treated effluent (grit removal, desedimentation, and degreasing with the help of chemical reagents (coagulant and flocculant) and a final disinfection in the chlorine contact tank.

The APT for domestic wastewater has many advantages when the effluent is reused for irrigation. Some highlights of the advanced primary treatment are as follows:

1. High degree of removal of TSS and Helminth eggs.

2. Removal of the only insoluble fraction of organic material (BOD, DQO) and leaving soluble organic material for irrigated crops.

3. Non removal of nitrogen, main crop nutrient.

4. Preservation of a good ratio of phosphorous, another main crop nutrient.

5. Considerable preparation of the clariflocculated effluent in order to reach acceptable conditions for the disenfection process, though this process utilizes relatively high amounts of chlorine (in the order of 15mg/l).

As such, the APT is an excellent technical - economical alternative for treatment of wastewater for agricultural reuse. It must also be noted that APT is also an excellent option in terms of process evolution treatment levels.

As its name implies, APT is a primary treatment that can be complemented with a secondary biological treatment, even a tertiary treatment. Therefore, changes to the process are not limited. Future, more stringent quality standards for the treatment of wastewater could be achieved by this process.

In this regard, it must be noted that economic factors required another option to be considered. It was determined to proceed in the initial treatment stages using an Advanced Primary Treatment process in order to comply with applicable regulations related to treated effluent quality in Cd. Juárez.

Specifically, when the purpose of the final treatment is to obtain a treated effluent that can be utilized in unrestricted irrigation, the number of Helminth egss must not exceed 1 HE/liter.

During pilot tests, the Mexican Institute of Water Technology was requested to analyze both untreated wastewater and the water treated by the APT pilot plant. The analysis demonstrated that untreated waters, the influent, had a level of Helmith eggs in the order of 10 to 30 HE/liter. However, the presence of these values has not been detected in samples taken during treatability tests.

In conclusion, although the purpose of treating Cd. Juárez wastewater is not for unrestricted irrigation, analysis results are very encouraging. They confirm a high degree of removal of Helmith eggs, the major contaminant restricting irrigation with treated wastewater. Furthermore, confirmation of this situation will increase the possibility of diversifying the type of crops currently being cultivated in the Irrigation District South of Ciudad Juárez.

b. Project Specification

The North and South plants are designed to treat volumes of 2.5 m3/s and 1.0 m3/s respectively. The design is based on a population study for the zone of influence using projections from 1992 through 2010.

Construction of the Advanced Primary Treatment process plants is expected to last 18 months; they will be concessioned to operate for 12 years; the effluent will comply with the discharge standards established by the CNA (120 mg/l of BOD_5, 120 mg/l TSS).

Charts 3.A and 3.B, show a schematic mass balance in the North and South Wastewater Treatment Plants for Cd. Juárez, respectively.

Table 3.A. Mass Balance for the *Norte* WWTP

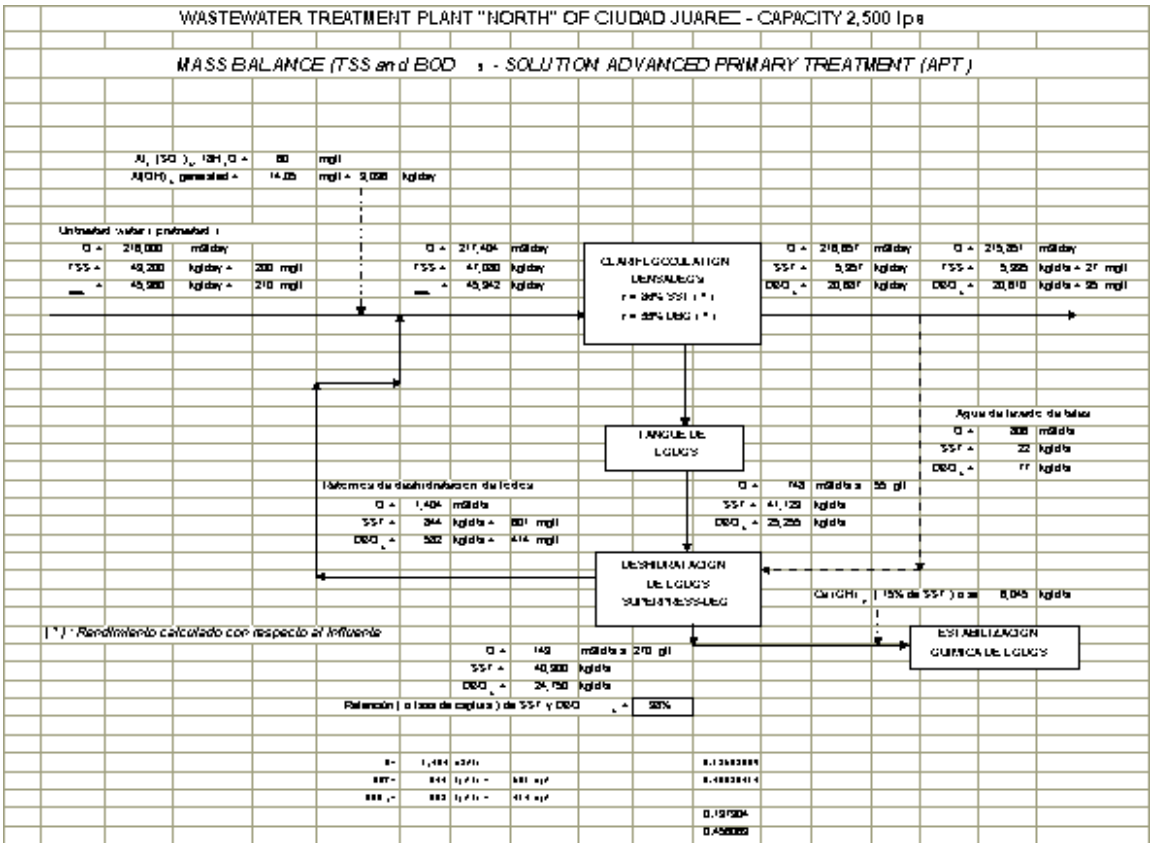
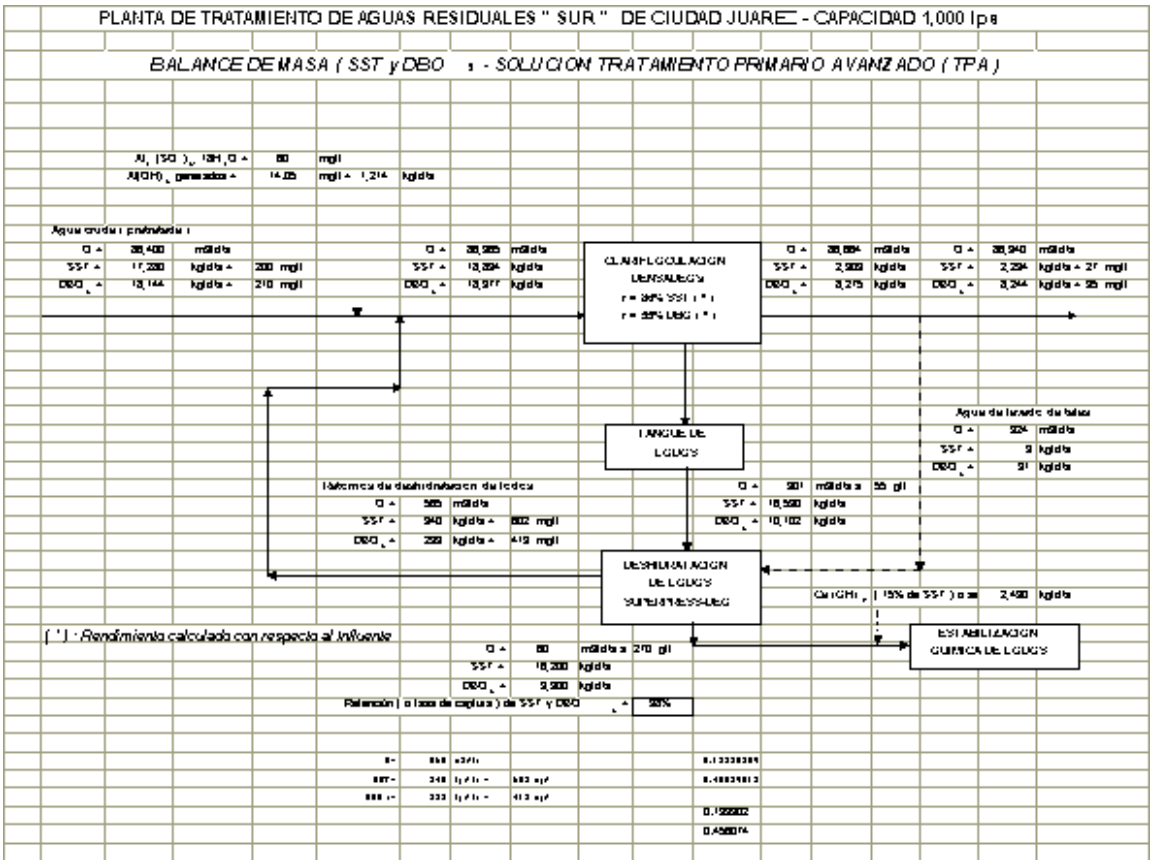


Table 3.B. Mass Balance of the South WWTP



Quality of influent. The City of Juárez discharges its wastewater into the Valley of Juárez. Here the wastewater mixes with waters from the Rio Grande River and water from agricultural wells for irrigation purposes. The wastewater test results showed the parameters described in Table 3.C.

Table 3.C Quality Parameters for Untreated Water

Parameters	UNIT	NORTH	SOUTH
Temperature	°C	20-35	20-35
pH	(-)	6-9	6-9
Conductivity	umhos/cm	1400	1400
BOD_5	mg/l	210	210
TSS	mg/l	200	200
Sedimentable Solids	mg/l	2.0	2.0
SDT	mg/l	1500	1500
Grease and oil	mg/l	55	55
Total Coliforms	NMP/100 ml	1.02×10^6	1.02×10^6
Fecal Coliforms	NMP/100 ml	3.0×10^5	3.0×10^5
Helmith Eggs	NHH/l	10-30	10-30
Cyanide	mg/l	< 0.01	< 0.01

Fluoride	mg/l	<1	<1
Aluminum	mg/l	<3	<3
Arsenic	mg/l	<0.01	<0.01
Boron	mg/l	< 0.5	< 0.5
Cadmium	mg/l	< 0.005	< 0.005
Copper	mg/l	<0.06	<0.06
Total chrome	mg/l	<0.05	<0.05
Iron	mg/l	<1	<1
Manganese	mg/l	<0.18	<0.1
Nickel	mg/l	<0.05	<0.05
Zinc	mg/l	<0.5	<0.5
Selenium	mg/l	<0.01	<0.01
Lead	mg/l	<0.02	<0.02

Source: Degrémont de México, S.A. de C.V.

Quality of the Effluent. Pursuant to Official Mexican Norm NOM-001-ECOL-1996, which establishes the maximum allowable limits of pollutants in wastewater for discharges into national waters, the Cd. Juárez wastewater treatment project is defined as a "Use in Agricultural Irrigation" under the column "River" in table 2 included in this Norm. Additionally, the treated effluent must comply with water quality standards and not exceed the established parameters in accordance with the specifications for the wastewater discharge permit issued by the National Water Commission (CNA) through the Concession Title No. 2CHH100312/24HMSG94 of the Municipal Utility (Table 3.D)

Table 3.D Quality Standards for Treated Effluent

PARAMETERS	UNIT	NORTH & SOUTH PLANTS
Temperature	°C	35
pH	(-)	6.5 a 8.5
Conductivity	mmhos/cm	2000
BOD_5	mg/l	120
TSS	mg/l	120
Sedimentable Solids	mg/l	1.0
Grease and oil	mg/l	15
Total Coliforms	NMP/100 ml	10000
Fecal Coliforms	NMP/100 ml	1000
Helmith Eggs	NHH/l	< 5
Cyanide	mg/l	< 0.02
Fluoride	mg/l	<3

Aluminum	mg/l	<5
Arsenic	mg/l	<0.1
Boron	mg/l	< 1.5
Cadmium	mg/l	< 0.01
Copper	mg/l	<0.2
Total chrome	mg/l	<0.1
Iron	mg/l	<5
Manganese	mg/l	<0.2
Nickel	mg/l	<0.2
Zinc	mg/l	<2
Selenium	mg/l	<0.02
Lead	mg/l	<5

Source: Concession Title No. 2CHH100312/24HMSG94 of the JMAS

In October 1995, a pilot plant was developed to examine the effects of the Advanced Primary Treatment on the City's wastewater at the North Plant location. The results obtained demonstrated the level of chemical reactors that should be utilized as well as the quality of the treated effluent.

Based on test results, it was determined that the Advanced Primary Treatment is an efficient process to reach the water quality standards required to comply with regulations, and both the Mexican Official Norm NOM-001-ECOL-1996 as well as with the Concession Title by the Municipal Utility. Table 3.E indicates the different speeds of flow tested and also the test results of the pilot plant.

Table 3.E Treated Water Quality Results of the Pilot Plant

PARAMETER	volume = 20 m3/h			volume = 25 m3/h			volume = 30 m3/h			Volume = 35 m3/h		
mg/l	raw	Treated	% Effic	raw	treated	% Effic	raw	Treated	% Effic	raw	Treated	% Effic
Total BOD_5	138	106	23	160	87	46	152	94	38			
Total DQO	356	162	54	261	148	43	382	197	48	470	164	65
Total PO_4	22.8	7.12	69	23.9	6.62	72	29.9	10.9	64			
NTK	35	26.9	23				34.4	27.7	19	29.7	26.9	9
Grease and oil	38.5	11.1	71	57.7	8	86	23	7.1	69	47.3	9.8	79
TSS	136	28	79	124	20	84	156	32	79	167	22.4	87
pH	7.4	7		7.4	7.2		7.4	7.2		7.4	7.2	

Source: Degrémont de México, S.A. de C.V.

Test results for treatment indicate that the TSS concentration at exit points is maintained at a constant level between 20 and 40 mg/l and that the elimination

efficiency levels of BOD_5 fluctuate between 25 and 45% to reach values below those established in the regulations.

Plant Estimations and Contributions

North Plant

As described in Chapter I, the present and future influent to the North Plant comes from 8,678.67 residential hectares and 1,476.81 industrial and service hectares. Likewise the inflow to the South Plant comes from 9,433.52 residential hectares, and 2,771.42 industrial and services hectares, in accordance with the Master Plan for Urban Development of Ciudad Juarez, as well as on the projected increase in population.

The service area for the North Plant, whose design flow is 2,500 l/s is considered sufficient for the project's life cycle since the projected population is low, see table 3.F

Table 3.F. Water Volume

Amounts conveyed by collectors to the North WWTP *(Data is average taken during Summer 1996)*

Parameter	North	Ejercito Nacional	Tomás Fernández	Punto 3	Other (*) collectors
BOD_5 (mg/l)	**119**	**173**	**152**	**91**	**-**
Volume (l/s)	***283***	***723***	***322***	***43***	***255***

Source: JMAS Sanitation Division

Other existing collectors include Fidel Velázquez, Valle Verde, Doblado and Juárez-Porvenir (1-B). which do not have estimations with compound samples. Measurements are taken at the site of the 1-A Drain and includes all collectors which end up conveying to the North WWTP, as well as waters from Treaty, to irrigation zone #1 (170 millions m3/year). These estimations vary from 2.0 to 3.3 m3/s.

As such, the current average volume of **flow at the North Plant is 1,500 l/s.** Projected estimates, shown in the Estimate Analysis of WWTP Wastewater, indicate the capacity is sufficient through the year 2010 with an average population growth rate. Taking into consideration that the maximum capacity of the North plant is 2,500 l/s, when it reaches capacity, future estimates will be conveyed to the South plant.

South Plant

With regard to the South Plant's service area, which has been classified as a residential development zone and which is also divided by the natural water divider and the zone called *El Barreal*, design flow has been estimated at 1,000 l/s.

Amounts conveyed by collectors to the South WWTP (Data is average taken during Summer 1996)

Parameter	**Jarudo 1&2**	**Satélite**	**Panam.**	**Rastro**	**Torres Tapioca**	**Waterf.**	**Bateria**
BOD_5 (mg/l)	**141**	**235**	**147**	**275**	**152**	**171**	**191**
Volume (l/s)	***346***	***11***	***110***	***346***	***322***	***8***	***322***

Source: JMAS

Volume at the **South plant** has an estimated average of **1,465 l/s.**

Table 3.G shows the estimates conveyed to the South Plant and projections through the year 2022.

Table 3.G Volume at the South Plant

ITEM	**Unit**	**1997**	**1998**	**1999**	**2000**	**2005**	**2010**
Supply	l/res/day	360	363	366	369	380	383
Demand	l/sec	2474.3	2685.81	2909.87	3147.14	4509.15	6156.84
Inflow	**l/sec**	**1410.74**	**1586.66**	**1782.32**	**1905.21**	**2595.22**	**3508.56**
(avg.)							
Max. Flow	l/sec	2539.34	2855.99	3208.18	3429.37	4671.40	6315.41
Min. Flow	l/sec	705.37	793.33	891.16	952.6	1297.61	1754.28

Source: Bidding Conditions for the South WWTP of Cd. Juárez/1993

As noted, the South Plant's capacity will be less than the volume of water being collected by the collectors. As such, the JMAS has developed an expansion program for the South Plant through a 500 l/s additional module. The module will be constructed in conjunction with the 1,000 l/s plant.

The JMAS was able to identify this problem during the bidding process for the concession of the WWTP in 1993, when expansion had been projected to begin in 1998. Due to the four year delay (1993-1997) in starting construction, capacity concessioned has been exceeded. At the same time, due to the concession contract between JMAS and Degremont, design capacities cannot be modified. In

accordance with Public Work regulations, contract amounts may be increased by 25 percent. Therefore, JMAS has considered contractually including expansion of the South Plant.

The expansion will begin once Phase I of the Plant starts and will be developed in conjunction with construction of the first 1,00s l/s module. JMAS has also considered future expansions to the South Plant, described in "Analysis of the Wastewater Inflow to the North and South Treatment Plants". The analysis also identifies future plant expansions under different scenarios in population expansion.

North and South Plants

Growth projections for wastewater inflow to the plants is described in the following table and is based on the population growth scenario described in the Urban Director Plan, which has been identified as the most feasible scenario:

Table 3.H Influent Projections

Year	Flow (l/s)
1998	2,979
2000	2,236
2005	3,695
2010	4,039

It must be noted that both facilities will be located in Irrigation District 009 and intend to irrigate crops with the treated effluent. This policy shall be applied based on the water reclamation program, developed by the National Water Commission (CNA), which is the agency managing the waters in Irrigation District 009 in the Valley of Juárez. This Agency will also design the reclamation program for the treated effluent since the only commitment made by the JMAS is to return the treated effluent in conformance with discharge conditions.

In addition, the JMAS is currently implementing programs whose aim is to make efficient use of resources and include the following:

- Industrial wastewater pre treatment program, currently operated by the Junta Municipal, which carries out contingent reviews, both for wastewater quality as well as for quantity; this has resulted in reduced consumption by industry.
- With the implementation and installation of water meters, savings in proportion to the volume of wastewater produced will be experienced.

These programs along with the economic factors (cost for water) have increased awareness regarding water use/savings by industry and have also resulted in reduced consumption as demonstrated in Table 3.F.

	VOLUME OF POTABLE WATER m^3/MONTH			
	1996	**1997**	**SAVINGS**	**%**
JANUARY	9,630,616	9,016,212	614,404	-6.4
FEBRUARY	9,842,430	8,477,462	1,364,968	-16.1

Source: JMAS. Technical Department

Technical Process

The equipment for the Advanced Primary Treatment for both plants consists of the following stages:

1. Pretreatment

- Influent comes in, grit removal and automatic heavy metal eliminator
- Pumping of first sludge from raw water (with Arquimides screw)
- Automatic screening/filtering of fine particles
- Aerated settling and degreasing

2. Primary Treatment

- Clariflocculation (in Densadeg Degremont reactors)

3. Final Treatment

- Disinfection (chlorination in the chlorine contact tank)

4. Sludge Treatment

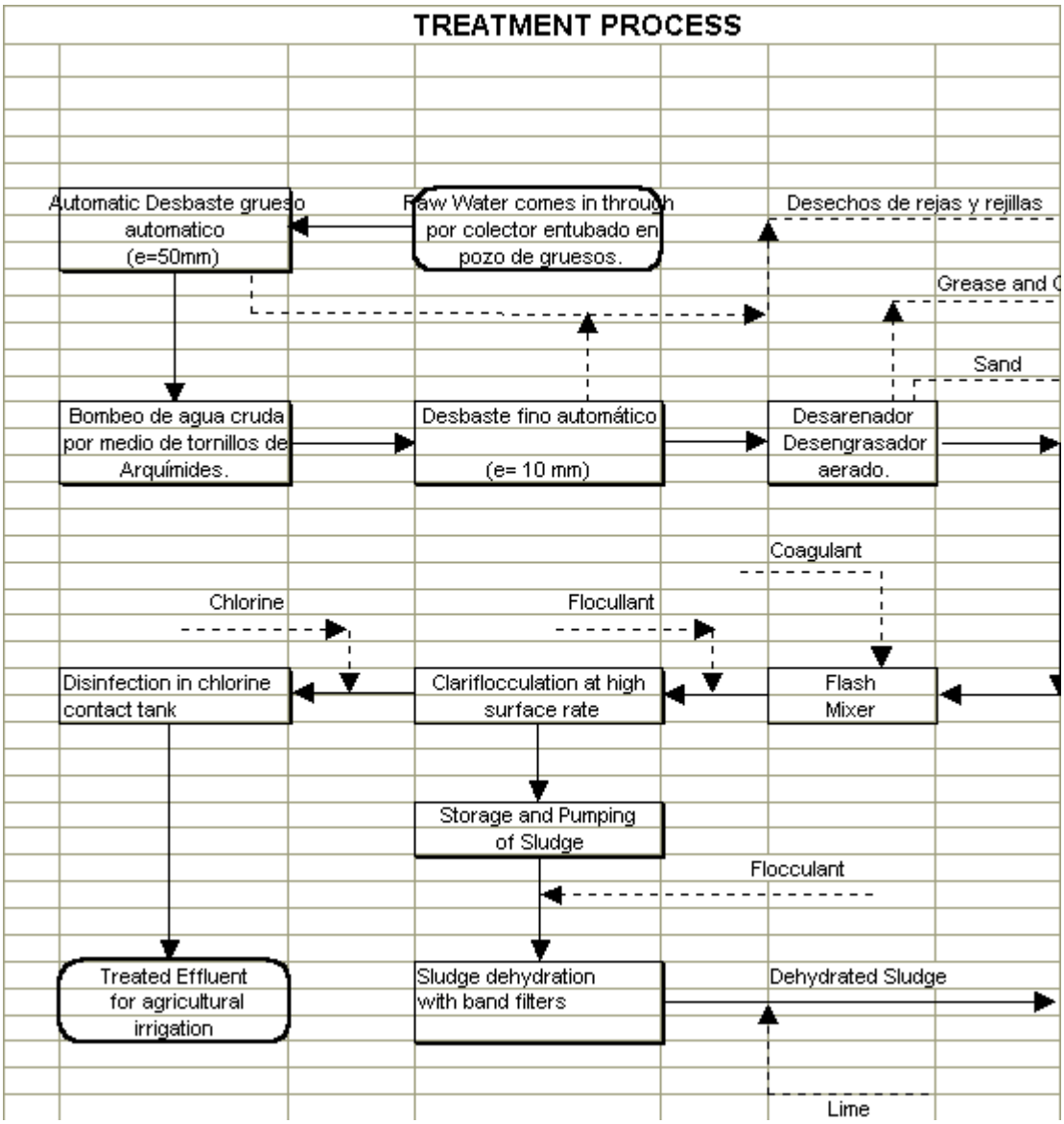
- Storage, pumping, and mechanical dehydration of primary sludge in pressing band filters
- Post lime treatment with caustic lime CaO of the dehydrated primary sludge

This treatment process has many advantages when treated effluent is used for agricultural purposes. Some of the major advantages offered by advanced primary treatment are the following:

- High removal rates of TSS and Helminth eggs

- Removal of the only Insoluble fraction of organic material (BOD5 and DQO), leaving soluble organic material for agriculture
- Non removal of nitrogen, main crop nutrient
- Preservation of phosphorous in the treated effluent, another main crop nutrient
- Excellent preparation of the clariflocculated effluent for acceptable disinfection conditions, though high amounts of chlorine are required (in the order of 15 mg/l).

The following chart shows the different stages:



Quantity and final disposal of sludge. Sludge shall be disposed at the municipal landfill; on March 10, 1995, the Municipal Public Maintenance Department issued permit number DGSP / DL / 651 / 95 for sludge disposal.

The North Plant will generate 46 tons/day and the South Plant 18.5 tons/day of sludge. Costs for sludge transport are included in the operation and maintenance contract with the concessionaire that also takes into account the 40 km distance from the plants to the landfill.

With this regard, quality characterization analysis have to be carried out to the sludge. Once its no toxicity has been verified, it could be disposed on the municipal landfill as non hazardous wastes. Preliminary results from the pilot plant suggests that the produced sludge will have no expected toxic components. It's also important that the JMAS has been carrying out a Program for Wastewater Discharges into the Sewer System. That program enables the JMAS to control the wastewater quality to be discharged to the system. Further information about this program can be found at the JMAS Capacity Building section.

Description of Supplemental Works

Sewerage at Colonia Km. 20 (East)

This colonia lacks sewerage infrastructure East of the railroad tracks. The project includes the installation of 7,972 meters of 8 to 15" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Km. 20 (West)

This colonia lacks sewerage infrastructure East of the railroad tracks. The project includes the installation of 4,000 meters of 8" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia El Safari

Installation of 4,055 meters of 8 to 15" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Morelos CDP

Installation of 10,025 meters of concrete 8" diameter piping. (See attached technical file)

Sewerage, sewer connections and collectors at Colonia Manuel Valdés

Installation of 7,915 meters of concrete 8 to 18" diameter piping. (See attached technical file)

Sewerage at Colonia J.M. Morelos - Zacate Blanco

Installation of 2,512 meters of 8 to 12" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Luis Donaldo Colosio

Installation of 3,079 meters of 8 to 10" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Felipe Angeles

Installation of 3,230.6 meters and 8" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Palo Chino

Installation of 3,478 meters, 8" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Médanos

Installation of 3,029.8 meters of 8" diameter PVC piping with hermetic joints. (See attached technical file)

Sewerage at Colonia Lázaro Cardanes - Aeropuerto

Installation of 2,938 meters of 8 to 12" diameter PVC piping with hermetic joints. (See attached technical file)

Construction of the Interceptor

Installation of 848.6 meters of concrete piping to complete the North interceptor that will convey water to the North WWTP and 1.07 to 1.52 meters in diameter. (See attached technical file)

Construction of the 2-A Collector left margin

For the South collection system (2-A, 2-C and Discharge collector). The collector runs parallel to the 2-A Drain that contains water from El Jarudo stream. Both margins start at Tecnologico Av. and Teofilo Borunda Blvd., and still need a final portion to run to the intersection with the Discharge Drain. This collector still requires 307 meters in concrete pipes1.22 meter in diameter on the right margin and 1650 meters of 0.76 diameter, 60 meters of 0.91 diameter pipes on the left margin. It also requires 31 manholes. (See attached technical file)

Construction of the Juárez - Porvenir Collector

Installation of 4,271 meters of 91 cm. diameter concrete piping for the Juarez-Porvenir collector at the Southern area, which will convey wastewater to the South WWTP. Diameter of pipes will be 91 cm. (See attached technical file)

Construction of the 2-C Collector

This collector is part of the entire South collector system and completion is required to the Discharge Drain which reaches the South WWTP. This collector drains Col. Fidel Avila and the final course also drains Colonias Flores and Moreno. The whole collector is composed of 2599.4 m of 0.76 m diameter concrete piping. Currently, 130 m. of 0.76 m diameter piping, including 2 manholes, have yet to be completed. (See attached technical file)

Replacement of a section of the Insurgentes Collector

The area drains an area whose northern perimeter is flanked by the Madera Drainage ditch and to the south by the tract leading towards the Doblado drainage ditch. The collector's entire area of influence is 711 hectares which has an estimated flow of 228 l/s. The growth area is estimated to be 20 has. with 8 lps consumption. In the area between Ave. del Charro y Ave. de la Raza to Ave. Lopez Mateos and Insurgentes 2055 meters of the collector will be replaced with 61 to 76 cm diameter concrete piping, and 32 manholes will be added. (See attached technical file)

Expansion of the Discharge Collector

The final section of the South collector system before it reached the South WWTP, drains at the start of its tract, waters from collector 2-C and the Col. Nuevo Zaragoza collector. The entire collector consists in 1779.6 meters of piping, 1.22 meters in diameter. The collector's area of influence includes 100.1 hectares and has an estimated 24.39 lps volume of flow. The future growth area

is estimated at 813.3 has with 306.67 lps consumption. (See attached technical file)

Sewerage in the Colonia Colinas Del Desierto

Installation of 1,960 meters of 8" diameter PVC piping with hermetic joints. (See attached technical file).

Sewerage in the Colonia Barrio Nuevo

Installation of 3,029.8 meters of 8" diameter PVC piping and 281.4 meters of 12"diameter PVC piping with hermetic joints. (See attached technical file)

Replacement of the P. Elias Calles Collector

Installation of 1,585 meters of 45 cm in diameter reinforced concrete piping with hermetic joints. 2,551 meters in reinforced concrete piping, 61 cm in diameter, and 250 meters of 122 cm. Reinforced concrete piping. (See attached technical file).

Replacement of the A. López Mateos Collector

Installation of 2,570 meters of 61 cm diameter reinforced concrete piping with hermetic joints. 275.3 meters in reinforced concrete piping, 107 cm in diameter, and 155 meters of reinforced concrete piping, 152 cm in diameter. (See attached technical file).

Replacement of the Bolivia Collector

Installation of reinforced concrete piping 1,700 meters long and 91 cm in diameter with hermetic joints. (See attached technical file)

Replacement of the Costa Rica Collector

Installation of 550 meters of 38 cm diameter PVC piping with hermetic joints. (See attached technical file)

Replacement of the Brasil Collector

Installation of 230 meters of 38 cm in diameter PVC piping with hermetic joints and 250 meters of PVC piping 45 cm in diameter with hermetic joints. (See attached technical file)

c) Operation and Maintenance Program

During initial stages of operation, a preventive maintenance program shall be established. The program will define the periodic equipment review, such as changes in oil and small parts in order to prolong equipment life cycle.

In the equipment acquisition program, a line item for "replacement parts" has been included in order to be able to rely on stock parts during initial operations. The amount of parts to be kept in stock shall be agreed between the constructor and the operator in accordance with recommendations submitted by suppliers. During operations, stock will be maintained at a constant level in order to resolve problems immediately.

The operational budget includes a line item for equipment replacement costs; these costs will be used to establish a fund for replacing deteriorated equipment. These three issues will ensure that service in conformance with treatment quality specifications will be continuously provided.

1.- Start Up Operations Program:

The training program is divided into two fundamental components:

- Knowledge of plant
- Knowledge of operation techniques

Knowledge of Plant. In order to operate and maintain the plants at optimum levels, complete knowledge of the plants is required. As such, operations personnel shall be hired during equipment assembly in order to have personnel participate in plant testing and start up operations. During initial operation stages, an inventory of all equipment along with recommendations and technical descriptions will be developed. This will facilitate any emergency situation.

Knowledge of operation techniques. The personnel contracted for plant operations will be provided a training course aimed at providing expertise on all management procedures as well as to ensure that all personnel has an understanding of all maintenance procedures that will be in place during the plant's life cycle. Training will be both theoretical as well as practical and will be provided by the plant director who shall be an experienced engineer in operations and maintenance.

The tentative start up operations program has been submitted in a bar graph for the North and South WWTP and is included in the attached Technical Feasibility prepared by Degremont of Mexico.

2.-Contingency Plan:

From the moment design stages were initiated, both for the North and South WWTP, special attention was given to ensure the design was the most flexible. As such, design of both plants has taken into account the possibility of treating 216,000 m3/day of wastewater at the North plant and 86,400 m3/day at the South plant with the same quality. Should any of the following equipment fail, this situation would prevail:

- Fine material removal screen
- Degritting and degreasing canal
- Flash Mixer
- Densadeg clariflocculator
- Pressing band filters for sludge dehydration

The plant has been designed in such a way that all its critical equipment (raw water pumps, circulation pumps, dosing aparatus for chemical substances, etc.) will have back up equipment on stand by. In case of an emergency, operations will not be shut down.

In addition, replacement pieces in stock will allow failing equipment to be repaired immediately in order to reestablish the safety system (stand by). The digital monitoring and control system will allow information to be obtained immediately and thus allow timely intervention.

The attached Technical Feasibility document, developed by Degremont of México includes: List of Engines, Operation and Emergency Response Program.

3.- Safety Plan and Contamination Prevention Program

We are certain that personnel safety is directly related to work efficiency levels, as such, all measures required to reduce all types of accidents will be taken. Therefore:

- The plant's safety system includes fire extinguishers in all critical areas of the plant, delay or manual circuit breakers for all equipment, direct communication lines with local hospitals and fire stations, a visible safety and preventive sign system at all critical locations, and special warning

signs indicating equipment has been temporarily shut down for maintenance.
- All employees shall be provided with safety equipment that includes gloves, safety belts for heavy lifting, hard hats, uniforms and protective eye wear.

During the training period during start up operation stages, as well as during the continuous training programs, safety issues will be covered in detail in order to ensure that all employees gain awareness of how importance safety is and also acquire skills required to address all types of emergency situations.

Included in the Technical Feasibility document, developed by Degremont of Mexico, the following has been included: Operation and Maintenance Manual for the Degremont Treatment Plant in Monterrey. This Manual contains detailed information regarding the procedures to follow in the case of an emergency to avoid any contamination.

Furthermore, the JMAS has contracted the services of an expert in the analysis of environmental risks for the North and South WWTPS. This will help identify any safety and buffer areas should a chlorine gas leak occur. It will also help identify a model to indicate the potential formation of chlorinated organic compounds during the disinfecting process.

4.- Closure and Post Closure Program

The operation and maintenance costs of the WWTP include a line item for equipment replacement. The replacement cycle will be every ten to twelve years although some equipment will require more frequent replacement. Furthermore, the JMAS has considered expanding the treatment process in the future in order reach higher quality efficiency levels in the conventional secondary treatment process. For this reason, a closure program has not been considered as part of the project since the WWTP have been designed to renovate themselves.

D. Conformance with all Applicable Design Norms and Regulations

The project will comply with applicable design norms from the time construction begins. As such, construction will comply with State Construction Regulations and all steel structure construction aspects will comply with the guidelines established by the American Institute of Steel Construction.

With regard to the construction and operation structures, all dead and live loads, wind loads and seismic loads, and for all structures housing machinery or support

equipment, these will be included in the analysis of load, vibration, or impact factors. All conditions of the full and empty tanks, both during the construction and operation phases will also be considered.

The elevated tanks and surface tanks will be constructed in accordance with the Norms and specifications under ACI-318R-89 and ACI-350-89 (American Concrete Institute and the American Society of Mechanical Engineers. For all earthquake and wind analyses, specifications described in the chapter related to Deposits and Tanks of the Design of Civil Engineering Projects of the Federal Electricity Commission will be followed (see the TPA Document of Degremont of Mexico).

4. FINANCIAL FEASIBILITY AND PROJECT MANAGEMENT

a. Financial Feasibility

As an introduction, it must be noted that the original proposal for the municipal wastewater treatment project for Cd. Juárez included secondary treatment through an activated sludge system at an estimated cost of $40 million dollars. Due to the country's economic situation, it was determined to modify the treatment process and replace it with a process that included more appropriate financial and economic conditions.

In addition, with the advent of new policies for wastewater management and changes in the regulations for compliance with particular discharge conditions (PDC), and pursuant to the New Official Mexican Norm NOM-001-ECOL-1996, new PDC's can now be approved by the C.N.A..

As such, the proposed project has a new design, and reduces the original investment from $40 million to $22.6 million dollars. The new design process is based on an Advanced Primary Treatment system which is normally used by other projects as a transition process, allowing the project to reach a highly efficient secondary process in the future.

B.O.T. Process

The Junta Municipal de Agua y Saneamiento of Ciudad Juarez awarded concession of the project to Degremont of Mexico, S.A. (DM) under a Build, Operate, and Transfer project.

DM is the concessionaire company that will be in charge of developing basic engineering, the pre proposal project, the executive project, construction, start up

operations, and operations and maintenance procedures for the North and South WWTP during a 12 year period.

The BOT process for this project does not affect BECC certification criteria and policies since the request for proposal, bid, and contract award process was carried out in July 1993, prior to creation of the BECC. In addition, the pre proposal project and the plant's basic engineering have already been developed.

Investment Budget

Based on the budget submitted by DM, the investment amount for the North and South Wastewater Treatment plants has been divided as follows:

Project: $22,628,200 dollars (at December 1, 1996 currency exchange rate equal to $178,763,000 pesos).

Sewerage System: $2.35 million dollars ($18,616,679 pesos) which will increase the sewerage services from 80% to 93%, making it compatible with the potable water services. The drainage collector investment is $4,377,540 dollars ($34,582,567 pesos).

Investment Summary

ITEM	***Pesos Dollars***
North & South WWTP	$178,763,000 22,628,200
Sewerage and Drainage	$18,616,679 2,356,542
Collectors and Plants	$34,582,567 4,377,540
TOTAL	**$231,962,245 29,362,310**

All prices are reflected for December 1, 1996 rates, for both the WWTP and the sewerage and collector systems. Financial projections have been made at constant prices of December 1, 1996.

The construction and start up operations program for both plants has been established to run 18 months. The same time period has been established for the development of the sewerage project described in the General Information chapter herein.

With regard to the costs of the lots for the plants, the North Plant which covers 23.6 hectares, has a purchase price of $11,084,661. The South Plant lot has a

purchase price of $7,524,981, and covers 23.5 hectares; both appraisals were done 1993. The JMAS has purchased both lots and are have been included in their assets and therefore not included in the project's total investment costs.

Project's Financial Structure

With regard to the project's financial structure, the financial scheme has been defined as follows:

Source	***Amount***		
	(pesos)	***(dollars)***	***(%)***
• ***Grants***			
FINFRA-C.N.A.	$ 87,593,870	$ 11,087,832	37.8
JMAS	$ 87,593,870	$ 11,087,832	37.8
Subtotal	**$ 175,187,740**	**$ 22,175,663**	**75.5%**
• ***JMAS resources***			
Own resources (APAZU)	$ 12,083,755	$ 1,529,589	5.2%
	$ 0	$ 0	0.0%
Subtotal	**$ 12,083,755**	**$ 1,529,589**	**5.2%**
• ***Equity***			
Degremont M	$ 44,690,750	$ 5,657,057	19.3%
Other	$ 0	$ 0	0%
Subtotal	**$ 44,690,750**	**$ 5,657,057**	**19.3%**
TOTAL	**$ 231,962,245**	**$ 29,362,309**	**100**

Source: JMAS-BECC-NADBANK

These amounts when updated to the date of expenditure, may vary slightly due to the inflation index calculated from December 1, 1996 to date.

It must be noted that the project's financial feasibility, based on this financial program, requires an increase in rates as described in section b of the Rate Model. The increase was established under the "Impacts of the WWTP & Complementary Works on the JMAS Finances" which has been attached to this document. The rate increase will be distributed with a crossed subsidy analysis in order to define the sanitation rate program to be implemented. The purpose of carrying out a crossed subsidy analysis is to have the least impact possible on disadvantaged users.

Source and Application of Resources

The following tables describe the source and application of resources based on the financial program described above.

- ***Application of the FINFRA-BANOBRAS resources:***

ITEM	*Pesos*	*Dollars*
North & South WWTP	$ 87,593,870	$ 11,087,831
Sanitary Sewerage	$ 0	$ 0
Trunk sewer for plants	$ 0	$ 0
TOTAL	**$ 87,593,870**	**$ 11,087,831**

NOTE: FINFRA contribution = 49% of the value of the WWTP's

- ***Application of the NADBANK (EPA) resources:***

ITEM	*Pesos*	*Dollars*
North & South WWTP	$ 46,478,380	$ 5,883,339
Sanitary Sewerage	$ 18,616,680	$ 2,356,541
Trunk sewer for plants	$ 22,498,810	$ 2,847,951
TOTAL	**$ 87,593,870**	**$ 11,087,831**

NOTE: NADBANK contribution to the WWTP's = (WWTP value) - (FINFRA contrib.) - (Degremont contrib.). The remaining funds will be applied to the sewer works.

- ***Application of the Degremont de México resources:***

ITEM	*Pesos*	*Dollars*
North & South WWTP	$ 44,690,750	$ 5,657,057
Sanitary Sewerage	$ 0	$ 0
Trunk sewer for plants	$ 0	$ 0
TOTAL	**$ 44,690,750**	**$ 5,657,057**

NOTE: Degremont contribution = 25% of the value of the WWTP

- ***Application of the JMAS resources:***

ITEM	*Pesos*	*Dollars*
North & South WWTP	$ 0	$ 0
Sanitary Sewerage	$ 0	$ 0
Trunk sewer for plants	$ 12,783,755	$ 1,529,589
TOTAL	**$ 12,783,755**	**$ 1,529,589**

NOTE: JMAS contribution = what is left for Trunk sewer.

Each square includes a note indicating the **calculation criterion** for each application of financial resources. As stated earlier, these figures reflect December 1, 1996 prices, and as such, when applied those contributions, they will vary based on the rate of inflation between December 1, 1996 and the date in which it is carried out. When updating the prices, the calculation criterion noted over each table above will be respected.

The NADBank will contribute with the funds through her Border Environmental Infrastructure Fund (BEIF) once approval is made by the US EPA. Hence, the BEIF will provide US$ 11,087,831 dollars plus any adjustment needed caused by the inflation rate. Due amount may change at the same rate as the funds provided by the Mexican Federal funds. The time and final destination of the Bank's contribution will be determined by the NADBank & USEPA in such way that the more benefits to the users can be achieved.

With regard on the contribution by the JMAS, it will be provided through the APAZU program. Such Program shares 30% contribution by the Utility's own resources with a 70% contribution by State or Federal Funds.

Operation and Maintenance Budget

The JMAS and DM have defined the operation and maintenance costs for the two treatment plants. This budget includes a line item for equipment replacement costs during the project's life cycle.

The following is a breakdown of the budget. Costs have been divided into fixed and variable costs for both plants.

	North and South Plants				
Item	**Fixed Cost/year**		**Variable Cost/year**		**%**
	($/year)	($/m^3)	($/year)	($/m^3)	
Electricity	2,017,315	.0183	1,662,266	.0151	10.01%
Personnel	5,362,096	.0486			14.58%
Chemical Reactors			16,010,047	.1451	43.55%
Work Media	1,727,095	.0156			4.70%
Sludge Transport	1,936,257	.0175	650,214	.0059	7.04%
Consumption	2,227,291	.0202			6.06%
Equipment Replacement	4,152,841	.0376			11.30%
Insurance and Bonds	1,019,373	.0092			2.77%
Total annual cost ($/year)	**18,442,268**	**.1671**	**18,322,527**	**.1660**	**100.0%**
Total operation costs:			**0.3331 $/m^3**		

The operation costs (at December 1, 1996 rates) include a joint expense of 3,500 lps, divided for the North Plant at 2,500 lps (78,840,000 m3/year) and for the South Plant at 1,000 lps (31,536,00 m3/year). The annual costs total $36,764,495 pesos and do not include the costs for chlorine.

When costs for chlorine are included in the treatment process, the annual costs reach $41,731,715 pesos for both plants.

Finally, the breakdown of the operation and maintenance costs, including equipment replacement, for a volume of flow of 3,500 lps, is the following:

Costs $/m^3

Cost of fixed operation 0.2121

Cost of variable operation variable 0.1660

Total Cost: 0.3781

Other JMAS Proposed Investments

The "Impact of the North and South WWTP on JMAS Finances", developed by the JMAS and BECC, analyzes the sanitation project's financial viability. Analysis includes the financial commitments of the JMAS as well as any future investments in infrastructure required for the provision of services. As stated herein, the JMAS rate increase structure enables it to make investments to expand water supply and sewerage services infrastructure, strengthen its institutional capacity, and other actions needed to maintain and improve the efficiency levels of the operation and profitability, which this projects hopes to obtain as well.

The concepts which have been included for the proposes investments can be classified as follows:

- Potable water system expansion

Conejos Medanos

New connections

Macro & micro metering

- Sewerage

New connections

- Sanitation

WWTP (expansion of modules, 500 l/s

- Institutional Consolidation

Billing system

Institutional

These investments have an average cost of $300.00 dollars ($2,400 pesos) for each new potable water and sewerage connection. An estimated $38 million dollars ($300 million pesos) will be required over the next 12 years and represent an additional investment to the investments for potable water expansion and additional wastewater treatment modules estimated at $25 million dollars ($200 million pesos), over the same time period.

b. Rate Model

Currently, the JMAAS does not charge users for the provision of sanitation services. Existing sanitation services include collection of municipal wastewater and conveyance to the Discharge Drain. The Drain conveys wastewater to the Irrigation District and any surplus to the Rio Grande River. The JMAS expects to establish a marginal monthly rate increase program once construction of the plants begins and will include charges for sanitation. In this manner, at the end of the construction phase, income received from the cumulative marginal increases to the user rates, as well as the increased billing efficiency levels, shall be sufficient to financially sustain the project in the long term, including the debt coverage.

In the above referenced analysis, "Impact of the North and South WWTP on JMAS Finances", the following increases in the Utility's income are experienced:

Scenario	**Fee Increase (Real)**
With US EPA funding	26%
Without US EPA funding	38%
Benefits with EPA funding	**12$**

The income level will be increased via rates, as such, the JMAS Administration Board has approved the establishment of the sanitation rate and it will be incorporated into the Utility's billing system.

In this regard, JMAS has considered carrying out a rate study of crossed subsidies in order to distribute the rate on service users.

In the last two years, the JMAS has undertaken significant measures to increase billing efficiency levels; as such, the operating board is currently able to establish a rate model that will have a minimal impact on the disadvantaged domestic users.

The cash capital flows described in Attachment 8 to this document indicate that the proposed preliminary rate increase program is adequate and also generates a cash capital flow to support debt amortization costs as well as operation and maintenance costs.

Sensitivity Analysis

The sensitivity analysis carried out describes three possible scenarios in population growth rates: liberal, average and conservative during the project's life cycle. These variables have a significant impact on the infrastructure required for new connections and expansion of potable water sources and wastewater treatment.

The financial variables evaluated were the interest rates and the other subsidies for additional investments. As a result of this analysis, varying levels in the rate increases were obtained to meet present and future JMAS financial commitments. Analysis do consider treatment of the real volume that reaches the plants.

Financial Break Even Analysis

The project reaches its break even point only when it recovers its costs. These costs are related to payments to banks and costs for operations and maintenance.

Attachment 9 includes financial projections under this scenario, with an internal rate of return (IRR) equal to the nominal bank interest rates and the corresponding rates.

c. Project Management

As described above, the plants' operation and maintenance will be carried out by the 12 year concession awarded to Degremont of México, S.A.. In this regard, in 1993, the JMAS and DM executed a contract to implement the project under a BOT process.

DM has extensive experience worldwide with projects of this nature. With regard to the organizational structure for the project's operation, the following diagram detailing the operational structure has been submitted for consideration by DM. In addition, there is also a description of the operating departments.

For project management, DM has established a company, Juarez Wastewater Concession, S.A. de C.V. (CAR), an affiliate company with legal jurisdiction to contract financial obligations and also constitute itself as a long-term debtor.

Furthermore, an Institutional Development Plan has been developed by the applicant and NADBank and has a cost of $731,000 dollars. The C.N.A. will contribute 42 percent and PRODIN will contribute the remaining $427,750 dollars.

6. COMMUNITY PARTICIPATION

1. Comprehensive Community Participation Plan.

The Junta has developed communication and outreach activities based on the BECC criteria and were primarily carried out during 1995. Outreach activities were intensified and meetings were held with certain sectors of the community.

The project sponsor started the certification process in May of 1995 before the first set of BECC criteria were approved (August 1995). The activities carried out during that year were done according to these August 1995 set of criteria.

Since the BECC authorized its new criteria (November 1996), the sponsor has updated the original Community Participation Plan and is near completion.

The objectives of the Plan, submitted to BECC, is to inform and communicate public opinion regarding construction of the Cd. Juárez wastewater treatment plants and supplemental works. If project meets the approval of the project, public will support the project.

The program was reactivated by the Citizen's Follow Up Committee, which had been established in 1995. Furthermore, meeting with professional associations and public opinion leaders were held. Project information was also made

available at public places. In addition, a media campaign, opinion surveys, and public meetings were also held.

2. Report Documenting Public Support

Among the 15 meetings organized by the JMAS to inform the public and the various sectors of the community, a public meeting was also held at the University of Texas at El Paso (UTEP), in El Paso, Texas, in addition to one on August 7th in Cd. Juárez. Both were held after giving the public 30 days prior notification in order for them to understand the impact of user fees. In those meetings, a description was given of the benefits of the new plants, the related projects intended to complement the treatment plants, and the financing scheme.

A report documenting public support has been delivered to the BECC. The report is based on 15 meetings held in 1997 where information was given on the project and public comments were heard. In every case, the public expressed their acceptance and support of all of the project's aspects. All persons surveyed indicated they supported the project 100 percent. They stated they approved the project's technical aspects and also stated they were willing to support pay user rates. (See Attachment on Community Participation).

The project is supported by Mexican municipal, state, and federal authorities as well as by regional planning entities (IMIP).

It must be noted that a small group of farmers in the first (agricultural) of three units, in the Valle de Juárez Irrigation District have attempted to relate an old property dispute regarding the drains no longer being used, with the construction of the treatment plants and the stabilized sludge disposal.

Based on the supposed relationship between these two factors, farmers have expressed concerns regarding the treatment plants stating there may be issues related to foul odors, sludge management, quality of water for irrigation purposes and plant location. However, the group's representatives have expressed to BECC that their demands do not mean opposition to the construction of the plants.

JMAS and Degremont of Mexico, have assured that treatment will consist of an advanced primary treatment and have responded in writing and verbally to those and all concerns raised.

7. Sustainable Development

The project will contribute to area's sustainable development in the following ways:

a. Definition and Principles

- The project will comply with the sustainable development principle of human beings being at the center of sustainable development concerns; and that human beings have the right to lead a healthy and productive life. To accomplish this, the project will decrease the appearance of waterborne diseases associated with the use of untreated water, such as: dermatosis caused by contact, amoebic dysentary, gastroenteritis, etc.
- Present and future generations' need for clean water will be met by the projects that will compliment the treatment plants since with pipe installation for the collector system, foul odors and the presence of harmful fauna will be eliminated, the city's image and public health will improve, and the risk of contracting gastrointestinal diseases will also be reduced.
- Currently, the sewer system covers 85% of the city and the Junta has plans to gradually increase it to 93% while still accounting for natural population growth during the project's fourteen year life span. As has already been mentioned, the project has a capacity to treat 100% of the wastewater collected in the drainage system, even when considering future growth projections.
- The project will meet present and future wastewater treatment needs in urban areas by utilizing, as previously mentioned, a modular design. This type of treatment has the flexibility to increase the treatment capacity when the volume of wastewater increases, as well as be upgraded to a more complete and efficient type of treatment if the wastewater quality drops below current levels.

b) Institutional and Human Capacity Building

The chapter on Financial Feasibility and Project Management covered in more detail the aspects of capacity building. However, a few of the things mentioned were the activities the Junta has carried out based on their own program of institutional strengthening, such as the rate schedule that will begin by introducing a monthly marginal sewer rate increase starting with construction of the plants. The income derived from the accumulated marginal increases to these rates, as well as the increased billing efficiency, will be sufficient for the long term financial sustainability of the project, including debt coverage.

The BECC in 1995 assisted the Junta in a study of the "Institutional Development of the JMAS". Adding this study to their own plan, the JMAS has implemented the following:

- Telemetry (Program 1996). Wireless Telemetry System for the Cd. Juárez Water Treatment System.
- Geographic Information System. Computerized system which maintains information regarding the city's water infrastructure in a database.
- Maximizing the efficiency of Computer Systems. Automated operations.
- Managerial Information System

The Telemetry and Geographic Information Systems merit special mention since they have had a strong impact on the Board's procedures and operations. The technical complexity of these projects will require the support of outside engineering firms.

The central computer system (IBM AS/400) was upgraded significantly in its processing capacity by increasing both primary and secondary storage capabilities.

As in other infrastructure projects, the JMAS has sought to utilize current technology that will enhance the Board's quality reliability, and service to meet current needs. These consider financial savings in its operations.

Information on the objectives, methodology, and scope of these programs can be found in Attachment 12 of this document.

Additionally, the JMAS has developed a very ambitious plan which has already demonstrated its effectiveness, by making progress and concrete results in the control and monitoring of wastewater discharge. The Department of Standards was created in 1993 with the principal objective of inspecting and enforcing water use and management, as well as final industrial, commercial, and services wastewater disposal services.

The Water and Wastewater laboratory has contributed significantly to the system's modernization. Among those contributions are the following:

1. Identification and location of wastewater sources for the purpose of measuring their quality and quantity.

2. Water used for equipment cooling processes reused in same equipment, toilets or in irrigation of landscaping, resulting in less of a draw on the aquifer which

was 142.28 million cubic meters in 1996 compared to 143.2 million in 1995. The savings derived from this type of reuse is significant given the increased demand on the aquifer from population growth.

3. Construction of pretreatment systems, depending on the type of process and the infrastructure that it has, at each one of the discharge points.

4. Dispatching of wastewater discharge permits to Industry with the idea of companies will comply with particular municipal discharge regulations, lessening the concentration of contaminants in their discharge.

5. Prevention, control and permanent monitoring of the sources of contamination to the sewer and drainage system throughout the city. This can be accomplished with a special box containing sophisticated detection equipment designed to detect volatile organic compounds and gases.

6. Permanent detection and timely repair program for system leaks.

Note: For more information on these programs, consult the attachment on "Discharge Control Program" JMAS 1997.

As already mentioned, the fundamental part of the strategic planning established in the Water and Sewer Master Plan takes into account the inclusion and development of the city's primary sewer infrastructure by constructing collectors and subcollectors in the general network, which is typical of Wastewater Treatment Projects and complementary municipal sewer projects. These are a combination of scheduled actions to bring about in medium and long term as is shown in the table of scheduled activities in section 2 clause c) of this document.

Regarding this point, it is important to mention the existing situation with the open air drain that runs from west to east and that discharges the storm water of the "El Jarudo" creek, which begins at the Casas Grandes highway and then covered with concrete until the Panamerican highway, where the drain continues towards the west carrying only storm water. Earlier, the storm water from this drain used to mix with wastewater from collector 2-A (Black Canal) at the Panamerican highway. Currently, 90% of the volume conveyed by Collector 2-A is complete, leaving only concrete piping for wastewater to be installed.

The CNA has recommended the drain continue functioning as part of the city's storm water system, so the storm and wastewater of Collector 2-A be separated and for the short term will be 100% channeled to that collector. See the technical

file attached to the termination of Collector 2-A. in Complimentary Sewer Projects JMAS 1997.

c) Conformance to Applicable Local and Regional Conservation and Development Programs

Master Plan for Urban Development. The North and South Wastewater Treatment Plants are located in the Environmental Integration Zone which is described in the Master Plan for Urban Development of Cd. Juárez (1995). The land in this zone was used for agriculture before the JMAS acquired it.

The Environmental Integration Zone covers approximately 1, 740 hectares used for agriculture and is located northeast of the city. Its northeast boundary is the U.S. border, while the remaining perimeter is flanked by urban areas.

The **Master Plan for Urban Development** of Cd. Juárez, Chihuahua, is registered in the National Planning System and complies with the National Development program provisions which encourage and promote highly favorable conditions for the best socioeconomic option for Cd. Juárez.

The Master Plan is a regulatory instrument that defines the primary zoning and urban structure of the city, as well as policies and priority programs that will consolidate the city's urban development and also protect natural and cultural resources. The Partial Plan for the Environmental Integration Zone considered this from the start by installing sanitation infrastructure in accordance with conservation strategies in a way that does not alter the area's ecological balance.

The Master Plan establishes a specific policy regarding controlled urban growth for the Environmental Integration Zone, allowing urban housing at a low density rate and complementary equipment and services operating under special standards for conditional use.

All development initiatives for the zone must seek harmony with nature in order to preserve, to the highest degree possible, the physical characteristics of the area. (PDDU, IMIP, 1995)

The **Comprehensive Border Environment Plan (P.I.A.F.)** identifies the most critical environmental issues facing the border area today as being directly related to population growth and with industrial and service sector development.

The Comprehensive Border Environment Plan seeks to dramatically increase support for the construction and expansion of wastewater treatment plants in the border area, as well as energize industrial wastewater pre-treatment programs.

- The project will comply with the general objective of sustainable development defined in the **Border XXI Program** document, published in 1996 by the Secretariat of Environment, Natural Resources, and Fisheries (SEMARNAP). Among the particular objectives planned for the next 5 years of the program are:

a) Under Natural Resources, subcategory "Forest and Soil Conservation," once treated effluent is used to irrigate crops, instead of the untreated wastewater currently being used, deterioration of agricultural lands will be largely preventable.

b) Under Water Resources, objective #2, "Contamination Prevention" it is stated: pursuant to each country's regulations, establish binational priorities and guidelines for the development of water pretreatment programs.

The project will meet the goals established in the Cd. Juárez Water and Wastewater Master Plan. It is also going to exceed the expectations regarding the coverage of services. As was mentioned, the project is will achieve 90% sewer coverage and 100% wastewater treatment coverage. There are several reasons why it is currently not possible to achieve 100% urban sewer coverage. Among them are:

- Legal ownership of the residential lots
- Illegal settlements in high risk areas (embankments, dikes, streams and areas prone to flooding).
- High infrastructure costs in low areas (requires re pumping).

However, JMAS proposes to provide sewerage and drainage services to these areas once the legal situation is settled and when addition financial support for the sewerage system equipment and replacement project is obtained. This will allow the project to provide service to the entire population in the urban area of Cd. Juárez, equal to 1,095,500 inhabitants in 1995. This population generates a wastewater flow of 2,450 l/s. The North and South plants have been designed to treat a total of 3.5 l/s and with the expansion project will be able to treat 4,500 l/s and thus provide service to 100 percent of the population by the year 2011.

Year	Population (inhab)	Flow (l/s)
1998	1,179,258	2,979

2000	1,238,633	3,236
2005	1,371,154	3,695
2010	1,484,805	4,039

- The **Urban Development Plan for the State of Chihuahua** is included in the National Planning System and includes some of the following important objectives:

Rationalize distribution of population in state lands and the economic activities located in the areas with the greatest potential for the state.

Promote comprehensive urban development balanced in the population centers.

Improve and preserve the environment in communities.

Provide favorable conditions for the communities to address its urban land, housing, public service needs, infrastructure and urban equipment needs.

d) Conservation of Natural Resources

- In reclaiming 100 percent of the treated effluent for agricultural irrigation, reliance on the Hueco Bolson Aquifer will decrease and thus support conservation of this resource. Furthermore, the secondary treatment process, or tertiary, will provide a high quality effluent than may eventually be reinjected into the aquifer and further avoid depletion.
- Crop rotation practices will prevent desertification as described in the "Plan of Action to Combat Desertification in Mexico", and also included in the "Report on the General Conditions of the Environment and Environmental Protection, 1993-1994" prepared by the Secretariat of Social Development (SEDESOL) and the National Environmental Institute (INE).
- Benefits for the environment and ground water resources will be obtained once wastewater not reclaimed for irrigation purposes and discharged into the River will have a higher quality due to the prior treatment.
- Furthermore, as stated above, the Municipal Potable Water and Sewerage Utility (J.M.A.S.), has developed a Comprehensive Water Conservation Program and in 1993 implemented the Industrial, Business, and Service Discharge Monitoring Program. The Program's main activities are described under Sustainable Development, section B, herein.

Defining the geo-hydrology of the area has provided information regarding the primary supply source and has prioritized the Comprehensive Program for Underground Water Conservation and Protection. Specifically it has provided

information on the condition of the Hueco Bolson as well as implementation and measures requiring urgent application, via some of the projects outlined below:

- Simulation of the underground water flow to examine the hydrodynamic operation of the aquifer.
- Simulation of level under several different utilization scenarios to identify the aquifer's future behavior.
- Program for Underground Water Protection to protect the supply sources from any potential contamination caused by human activities.
- Simulation of contaminant transport pathways to identify compounds naturally present and those which could possibly be present in the aquifer in the future.
- Simulation of soil subsidence to prevent potential sinking in the city caused by lack of water in the clay strata.
- Model for optimum management, in which all variables are considered and which include geo-hydrology as well as those related to human activities, in order to obtain efficient levels of resource utilization.

e) Community Development

Community development activities have been fully considered and been taken into account. As such the project encourages via diverse mechanisms community development and also addresses not only the water needs of the farming community, but the needs of the entire community. The attached Social Evaluation, under chapter I, prepared by the Deputy Directorate of the Financial Engineering and Sector Project (D.A.I.F.P.S.) regarding the Cd. Juarez WWTP, includes the following aspects

- Economic development will be promoted when the treatment plants begin operations by creating 50 full time permanent positions. Furthermore, the related development plans will benefit neighboring property owner's and worker's financial situation and the community at large.
- Farmers currently utilizing wastewater for irrigation will experience an increase in their income levels due to the increased crop yields resulting from an increase in surface areas and also having higher quality water for irrigation. They will also be in the position to exchange crops for more profit yielding crops. (See benefits under the Agriculture chapter of the D.A.I.F.P.S. study).
- Increase in the value of land surrounding the wastewater conveyance lines and the installing of pipes (complementary project) and the appropriate development of urban equipment in areas of influence.

- A permanent Environmental Education Program for the community and the farmers of the Valle de Juárez will provide training on the correct use of treated waters. In elementary schools and middle schools, through special summer courses and seminars children will learn about the Water Culture. Programs will focus not only on water conservation issues but also on treatment and reclamation alternatives
- The social impact seen through the educational and cultural perspective based on the reutilization of a valuable resource required for life. Specifically, in a region whose supply source, the Hueco Bolson, has been over exploited, and given the degree of depletion, requires drastic and immediate mitigation measures to be taken.