IFC International Finance Corporation
World Bank Group

Cumulative Impact Study
Uruguay Pulp Mills

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PREAMBLE

Two European pulp producers have been developing pulp mill projects along the Río Uruguay near the city of Fray Bentos, Uruguay. Oy Metsä-Botnia Ab from Finland (Botnia), is developing the Orion project and Grupo Empresarial ENCE S.A. (ENCE), from Spain, is developing the Celulosas de M'Bopicuá (CMB) project. Both have prepared and publicly disclosed environmental and social assessments that describe the expected impacts of their projects and the mitigation and enhancement measures to manage those impacts.

To complete the assessment of the combined environmental and social impacts of the two proposed mills, IFC commissioned a Cumulative Impact Study (CIS) of the construction and operations of the two pulp mills and their respective raw material sourcing. The draft CIS was prepared by Pacific Consultants International and Malcolm Pirnie Incorporated and released in December 2005. Following a period of public review and professionally facilitated consultations in Argentina and Uruguay, IFC commissioned a panel of independent experts to review existing project documentation and all comments provided by stakeholders. The results of this review are summarized in a report issued by the independent experts in April 2006. The report, referred to as the Hatfield Report, also identifies additional information and analysis required to complete the environmental assessment for the two mills.

EcoMetrix Incorporated (EcoMetrix) and its consultants, SENES Consultants Limited (SENES) and Processys Incorporated (Processys), revised the draft CIS in response to the recommendations of the Hatfield Report, the published Terms of Reference, original research and modelling, stakeholder commentary and other project related documentation.

The CIS was prepared on the assumption that both the Orion and CMB pulp mills were going to be located at already selected sites near Fray Bentos, Uruguay. On September 21, 2006, ENCE's President made a public announcement indicating the Company's intention to relocate its CMB pulp mill. Therefore, readers of this cumulative study, which was initiated 14 months prior to ENCE's announcement, should now view all references to cumulative impact on the environment of the region as being correspondingly less taking into account only the Orion pulp mill will be operating at the Fray Bentos location.

EXECUTIVE SUMMARY

INTRODUCTION

The Botnia mill is located alongside the Río Uruguay approximately 5 km upstream (east) of the city of Fray Bentos near the end of the Libertador General San Martin International Bridge that connects Argentina and Uruguay. The site is currently under development with the port, stack and civil structures near completion. The ENCE mill is located approximately 11 km upstream (east) of the city of Fray Bentos on a site that currently contains a wood chipping plant and port facilities of the Terminal Logistica de M'Bopicuá.

Project Description

Botnia and ENCE are each proposing to develop a bleached Kraft pulp mill designed to produce approximately 1,000,000 tons of air dried pulp on an annual basis (ADt/a) and 500,000 ADt/a, respectively at full production. The wood will be sourced from established eucalyptus plantations within western and central-north Uruguay. The wood is processed by mechanical chipping, screening, cooking, bleaching and drying to separate it from water and lignin (natural glue that holds the fibre together in the wood) to produce pulp. The pulp will be exported to markets in Europe, Asia and other countries. The projects also include infrastructure for the supply of raw materials, water and energy, and for the storage, transport and disposal of waste and primary and final materials.

Regulatory Context

The Department of the Environment (Dirección Nacional de Medio Ambiente, DINAMA), as part of the Ministry of Housing, Territorial Planning, and Environment (i.e., Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, MVOTMA), is the agency directly responsible for the administration and enforcement of the environmental laws and regulations of Uruguay.

Specific laws require project proponents to conduct Environmental Impact Assessments (EIA) which describe the projects, evaluate the potential environmental effects, and develop monitoring plans and mitigation strategies. The mill proponents have submitted their respective EIAs to DINAMA as required. Following approval of the EIA, and after all conditions were met, the proponents were granted an initial environmental authorization (Authorización Ambiental Previa, AAP) for the project. The AAPs are an initial authorization for the mills. They identify certain restrictions such as compliance with all effluent limitations set forth in Uruguayan law (i.e., Decree 253/79); compliance with limits on other water quality parameters (e.g., AOX, nitrogen and nitrates); and compliance with the commitments made in their respective EIAs. The AAPs also require the mills to comply with international surface water quality standards developed by the Administrative Commission of the Río Uruguay (Comision Administradora del Río Uruguay, CARU). These water quality standards are approved by the Governments of Argentina and Uruguay and

are considered by these Governments as acceptable and adequately protective of the aquatic environment of the Río Uruguay.

For the construction and operation phases of the mills, the project proponents are required to submit detailed Environmental Management Plans (Plan de Gestión Ambiental, PGA) at which time additional requirements and safeguards may be stipulated by DINAMA. To date, ENCE has received authorization to commence earth movement to prepare the site for further construction of the mill and associated infrastructure, and Botnia has received authorization to construct the port, stack, concrete plant, foundations, bleached cellulose plant, wastewater treatment plant and a chlorine dioxide plant, and to operate the harbor terminal during the construction phase of the mill.

A separate authorization is required before operations can begin. The Environmental Authorization of Operation (Autorización Ambiental de Operación, AAO) will only be issued after construction is complete and a compliance monitoring plan has been submitted and approved. To ensure that operating standards and procedures continue to be state-of-the-art, the mills must request a renewal of their AAO every three years. At each renewal, Decree 349/005 empowers DINAMA to impose additional protective conditions on the project proponent, if additional requirements and safeguards are considered necessary.

Cumulative Impact Assessment

The International Finance Corporation of the World Bank Group (IFC) is currently assessing the two pulp mill projects in Uruguay for financing. In addition, the Multilateral Investment Guarantee Agency (MIGA) is evaluating whether to provide political risk insurance to the Botnia mill. To complete the assessment of the combined environmental and social effects of the two proposed mills, the IFC commissioned a Cumulative Impact Study (CIS) of the two pulp mills and their respective raw material sourcing. The draft CIS was released in December 2005 at which time it underwent a period of public review. The IFC also commissioned a panel of independent experts to review existing project documentation and all comments provided by stakeholders, including the Argentine Government. The results of this review are summarized in a report issued by the independent experts in April 2006 and available in Annex H. In particular, the experts directly addressed most of the issues identified by stakeholders and the Argentine Government. The report, referred to as the Hatfield Report, also identifies additional information and analysis required to complete the environmental assessment for the two mills. Table 1.8-1 provides cross references to where issues and findings raised by the independent experts are addressed within the CIS.

EcoMetrix Incorporated (EcoMetrix) and its consultants, SENES Consultants Limited (SENES) and Processys Incorporated (Processys), revised the draft CIS in response to the recommendations of the independent experts, the published Terms of Reference, original research, stakeholder commentary and other project related documentation. This report and its accompanying Annexes represent the final version of the CIS document as prepared by the EcoMetrix project team.

PROJECT DESCRIPTIONS

Wood Supply

An estimated 175,000 ha of eucalyptus plantations will be required to supply the two mills during their first eight years from start-up. Subsequently, a total of 208,000 ha of eucalyptus plantations will be needed to support the two pulp mills on a sustained basis. (At full production, Botnia's mill will require 3.5 million m^3 of eucalyptus per year and ENCE's mill approximately 1.7 million m^3 for a total of 5.2 million m^3 per year). In the western and center-north areas of Uruguay within convenient transportation distance of the pulp mills, are approximately 260,000 net ha of plantation. Both companies anticipate that supplies from their own lands, along with those from third party contractors will be sufficient to ensure adequate supply within an economically viable range for transport.

Both ENCE and Botnia are committed to ensuring that their own and associated supplier plantations are sustainably managed and do not have detrimental environmental and social impacts. The companies operate their plantations to Forest Stewardship Council (FSC) standards which require periodic certification. The companies also are requiring their suppliers to obtain independent certification of their forest management practices, through FSC certification. For more detailed information see Section 4.2 of Main Report and Annex B.

Site Selection Process

Both Botnia and ENCE undertook detailed site selection evaluations based on macro- and micro-scales. Macro-scale factors included: location on the Río Uruguay (transportation, water supply and wastewater assimilation), proximity to eucalyptus plantations (wood transport costs and transportation impacts), and existing infrastructure (roads, electrical grid, educated workforce and services). Both companies decided to locate their pulp mills in Fray Bentos. Logistical factors played a key role in the companies' decision making, however environmental and infrastructural aspects were also important.

Distance from sensitive natural and cultural areas was an important consideration in the micro-scale evaluation. Both companies decided not to locate their pulp mills near the former Anglo meat processing plant because of its proximity to Las Cañas and Ñandubaysal – coastal recreation areas on the Uruguayan and Argentine sides of the river, respectively, near Fray Bentos. ENCE decided to minimize visual impacts by locating its site at a distance from urban areas. Enabling people to live within the city instead of in the rural areas was an important consideration for Botnia in their micro-scale site selection process.

Ports at M'Bopicuá, the Botnia mill and Nueva Palmira will be used for the export/import of pulp and other supplies for the mills. Ports along the Río Uruguay have already experienced increased traffic because of increased log and woodchip exports. More

detailed information regarding site selection considerations can be found in Section 2.3 of the Main Report and Table 2.3-1.

Bleached Eucalyptus Kraft Pulp (BEKP) Mill Processes

The kraft or sulphate process is the dominant pulping process worldwide, due to superior pulp strength properties, its applicability for most wood species, the ability to recover and reuse the main process chemicals, and its energy efficiency. The main environmental concerns with kraft pulping include wastewater effluent, emissions to air including malodorous gases, the management of solid waste residuals, and energy consumption.

The kraft process is used in the production of paper pulp and involves the use of caustic sodium hydroxide and sodium sulfide (called white liquor) to extract the lignin from the wood fibre in large pressure vessels called digesters. The unbleached pulp is washed and the separated spent pulping liquor, called black liquor, is concentrated by evaporation and burned in the recovery boiler to generate high pressure steam for the mill processes. The inorganic portion of the black liquor is then treated to regenerate the sodium hydroxide and sodium sulphide needed for pulping. The pulp is bleached and dried for shipping to market. More detailed information on bleaching processes and an analysis of the elemental chlorine free process as compared with total chlorine free can be found in Section 2.5 of the Main Report and Annex A.

Comparison of Expected Mill Emissions with BAT

The most widely accepted definition of Best Available Techniques (BAT) and the basic standard that has been used in this CIS for the environmental evaluation of the Botnia and ENCE pulp mills is the so-called IPPC-BAT (2001). The definition of Best Available Techniques (BAT) considered in IPPC-BAT (2001) is “the most effective and advanced stage in the development of activities and their methods of operation which indicates the practicable suitability of particular techniques for providing the basis for emission limit values designed to prevent, and where that is not practicable, generally to reduce the emissions and the impact on the environment as a whole”.

The Tasmanian-AMT (2004) and the USEPA Cluster Rule standards were also used in this CIS for reviewing the mills to further evaluate whether the high design standards have been applied. In order to assess BAT for the Botnia and ENCE mills, the following methodology was systematically executed for the purposes of this CIS:

1. ***Assessment of the mill’s compliance with the emission levels achievable with the use of BAT****:* Based on emission levels from the IPPC-BAT (2001) and Tasmanian-AMT (2004) standards, it was found that the mills are implementing BAT. Furthermore, a comparison was made between the proposed mill emission rates and other mills including state-of-the-art BEKP mills in Brazil, as well as other well-operated Botnia and ENCE mills. It was found that the proposed emission rates for the new pulp mills were generally in the same order

or better than these mills. For more information on emissions and BAT see Sections 2.7, 4.4 and 4.6 of the Main Report, and Annexes A, C and D.

2. ***Assessment of whether DINAMA has a comprehensive plan to ensure the BAT standard will be met through their permitting process and requirements****:* DINAMA is employing a staged process to issue management plans for each of the two pulp mills as engineering and construction activities progress, which should eventually lead to the AAO or operating permit for the mills. Both concentration-based and loading-based discharge requirements are expected for the effluent and well-defined atmospheric emission limits. The companies and DINAMA are currently defining monitoring and reporting requirements, which will be used as the basis for the operating permit renewal required every three years. For more detailed information on monitoring plans and requirements see Section 5 of the Main Report and Annex D.

3. ***Assessment of whether BAT has been included in the mill equipment design****:* IPPC-BAT (2001), Tasmanian-AMT (2004) and certain USEPA Cluster Rule (2000) requirements were considered, and targeted issues have been discussed in greater detail in sections of Annex A. In summary, both mills will employ state-of-the-art process technology. For more information see Sections 2.5-2.7 of Main Report and Annex A.

4. ***Assessment of BAT operating requirements****:* The Botnia and ENCE mills were evaluated regarding their plans for solid waste management practices, monitoring plans including those implemented in other operating mills, training and motivation of mill personnel, process control, equipment maintenance, environmental management systems (EMS), and plans for communication with the community. Based on past practices and the current status and evaluation of programs to address these issues, it is anticipated that state of the art practices will be employed by both mills. For more information see Section 5 of Main Report and Annex A.

ENCE and Botnia have combined their operating experience and process knowledge with vendor offers to develop mill configurations that would be accepted in Canada, the USA or Europe. The mills will employ state-of-the-art process technologies in every respect and it is anticipated that once they are operational, they will perform better than any of the companies' existing mills with respect to environmental performance. The selection of two-stage oxygen delignification, ECF-Light bleaching and the cautious approach to alkaline filtrate recycling taken by both mills is consistent with BAT for BEKP mills, and the mills will implement state-of-the-art Hexenuronic acid removal stages in their bleaching sequences. The expected performance with respect to bleaching effluent flow, COD content and color will be among the best in the world.

ENCE and Botnia will meet and exceed IPPC-BAT (2001) and Tasmanian-AMT (2004) measures to control odorous gases from the recovery boiler and kiln, including efficient combustion control and CO measurements in the recovery boiler and control of excess oxygen and residual sodium sulphide in the lime kiln. Both mills have an extensive and comprehensive dilute gas collection system, and use the recovery boiler as the primary point of incineration. ENCE uses a biomass boiler as back-up, while Botnia uses a dedicated lean gas fire-tube boiler as back-up. The provision of a back-up for the dilute gas system and also the inclusion of white liquor preparation sources goes significantly beyond the IPPC-BAT (2001), Tasmanian-AMT (2004) and USEPA (MACT) requirements. The strong gas system in both mills collects strong odorous gases, and incinerates them in the recovery boiler.

The IPPC-BAT (2001) standard establishes achievable emission levels for a certain number of key parameters for bleached kraft pulp mills. The range of discharges rates is compared with the estimates provided by the companies in Table ES-1. The summary of mill emissions in the table is for the total emissions to each of the air and water receiving environments. As for fugitive emissions, in particular those from the wastewater treatment plant, these are expected to be very low for both mills because of the low sulphidity level of the eucalyptus pulping process and because of the extensive spills collection system to be implemented.

In summary, based on the above analysis, the BEKP mills proposed by Botnia-Orion and ENCE-CMB are considered by the CIS project team to be IPPC-BAT (2001) or better.

Table ES-1: Comparison of Emission Rates (annual average)

	IPPC-BAT (2001) Guidelines	World Bank Group Emission Guidelines	Botnia-Orion Long-Term Average	ENCE-CMB Long-Term Average
Effluent				
Flow (m^3/ADt)	30 – 50	-	25	29
BOD_5 (kg/ADt)	0,3 – 1,5	-	0,3	0,6
COD (kg/ADt)	8 – 23	15	8,0	8,7
AOX (kg/ADt)	< 0,25	0,20	0,08	0,10
Suspended solids (TSS, kg/ADt)	0,6 – 1,5	-	0,7	0,9
Total nitrogen (kg/ADt)	0,1 – 0,25	0,4	0,15	0,17
Total phosphorus (kg/ADt)	0,01 – 0,03	0,05	0,012	0,017
Air emissions				
Particulate matter (kg/ADt)	0,2 – 0,5	-	0,30	0,34
Total S (kg/ADt)	0,3 – 0,6	1,0	0,35	0,26
SO_2 (as S) (kg/ADt)	0,2 – 0,4	-	0,30	0,23
NO_x (as NO_2) (kg/ADt)	1,0 – 1,5	2,0	1,35	1,30
TRS (as S) (kg/ADt)	0,1 – 0,2	-	0,05	0,03
CO (kg/ADt)	-	-	1,7	1,7

ECF vs. TCF Bleaching Processes

Totally Chlorine Free and Elemental Chlorine Free pulp manufacturing processes have similar environmental impacts from air and water emissions, and neither emit dioxins at environmentally significant levels. TCF pulps generally have poorer strength at equivalent brightness, and lower yields than comparative ECF pulps. Neither technology offers significant advantages in terms of operating risk, safety and occupational health considerations. Both technologies are acceptable under the Stockholm Convention of POPs, IPPC-BAT, USEPA and all significant permitting authorities.

Oxygen delignification reduces the lignin content of pulp prior to bleaching, through the use of oxygen gas and sodium hydroxide. Modern two-stage delignification is proposed by both the Botnia and ENCE mills. The use of two-stage oxygen delignification has replaced the single stage system originally proposed by ENCE in the Draft CIS. For hardwood pulp and

specifically for eucalyptus, two stage systems may not significantly increase the amount of delignification due to the presence of Hexenuronic Acid, which is not removed in oxygen delignification. However, two stage systems give more operating flexibility and better control.

The principal BAT for minimizing or eliminating the formation of dioxin and furan (specifically the congeners 2,3,7,8- Tetrachlorodibenzo-p-dioxin and 2,3,7,8-Tetrachlorodibenzofuran) in wood and non-wood bleaching processes include:

- reduction of the application of elemental chlorine by decreasing the multiple or increasing the substitution of ClO_2 for molecular chlorine;
- elimination of elemental chlorine by replacing it with ClO_2 (elemental chlorine-free or "ECF" bleaching) or with chlorine-free chemicals;
- utilization of DBD- and DBF-free defoamers;
- effective brownstock washing to enable the reduction of chlorine multiple;
- maximization of knot and dirt removal to enable the reduction of chlorine multiple; and
- elimination of the pulping of furnish contaminated with polychlorinated phenols.

All of these BAT factors have been incorporated in the design of the beach plants at both the Botnia and ENCE mills.

Two approaches have been taken by pulp manufacturers in response to concerns on dioxin emissions from mills using chlorine bleaching in the 1980s. One approach was to eliminate molecular or elemental chlorine-based chemicals (i.e. bleaching sequences in which molecular chlorine (Cl) and hypochlorite are not used), referred to as ECF bleaching. The second approach was to bleach with no chlorine-based chemicals, which is called TCF bleaching (i.e. bleaching with oxygen, ozone, alkaline or acidic peroxide). Botnia and ENCE were leaders in the adoption of TCF technologies and today 21% of Botnia's and 38% on ENCE's production is manufactured using the TCF process. In selecting a bleaching technology for Uruguay, both companies investigated a range of ECF, TCF and ECF-Light technologies (an "ECF-Light" technology essentially has attributes of both ECF and TCF production). The ECF-Light technologies were selected as pulp from the TCF sequences has lower yields and poorer final quality than the ECF and ECF-Light pulps.

With the wood species that grow in Uruguay, ENCE found that pulp using the TCF bleaching method could not reach the necessary market brightness and Botnia has found that TCF bleaching produces inferior fibre quality, namely fibre strength.

The ECF versus TCF question was recently examined by the Government Agency (RPDC) responsible for permitting new pulp mills in Tasmanian, Australia. The RPDC review concluded that TCF pulp and ECF pulp have similar environmental impacts from air and

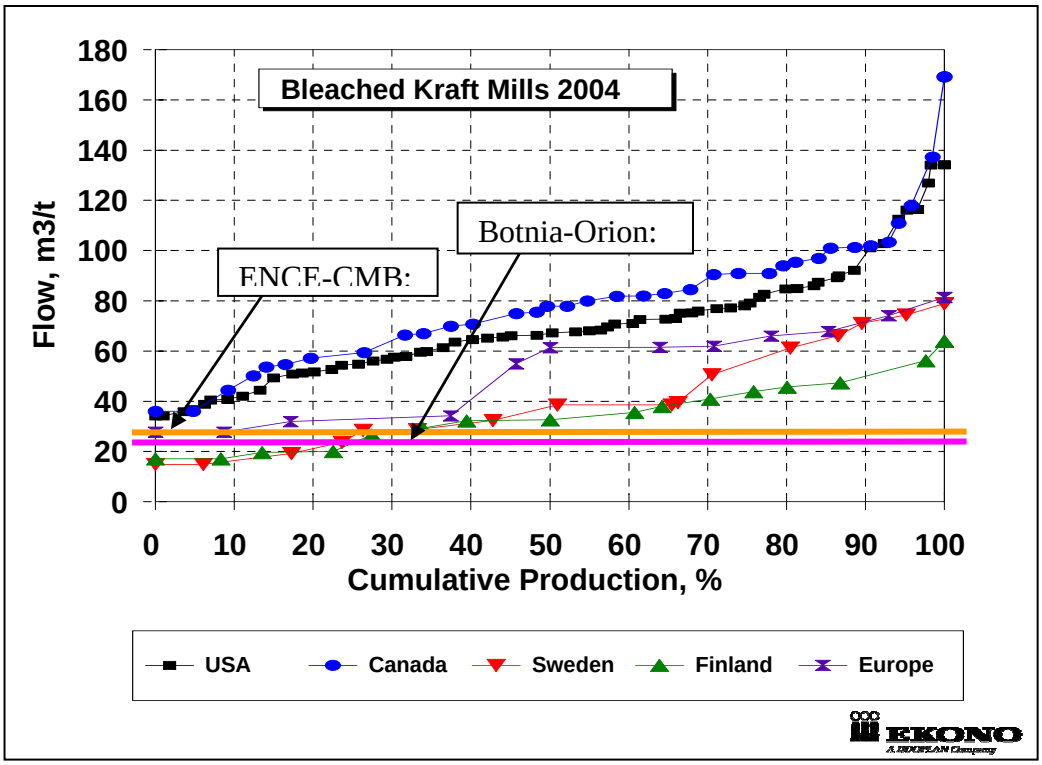
water emissions, and neither emitted dioxins at environmentally significant levels. Neither technology offers significant advantages in terms of operating risk, safety and occupational health considerations. Both technologies are acceptable under the Stockholm Convention of POPs, IPPC-BAT, USEPA and all significant permitting authorities.

For more detailed information see Section 2.5-2.6 of Main Report and Annex A.

Mill Processes: Effluent Treatment

The effluent treatment plants for both the Botnia and ENCE mills will employ the activated sludge treatment (AST) process, treating average discharge flows of approximately 73,000 m^3/d (25 m^3/ADt) and 46,000 m^3/d (29 m^3/ADt) respectively.

The IPPC-BAT (2001) standard considers an effluent discharge flow range of 30 to 50 m^3/ADt to be achievable by BAT mills. Both proposed mills will do better than the IPPC-BAT guideline. Effluent flows from the Botnia and ENCE mills also compare favorably with pulp mills around the world.



An efficient biological effluent treatment system is a critical element of BAT. Secondary or biological wastewater treatment by the activated sludge treatment (AST) process is widely implemented in the pulp and paper industry for the removal of organic matter. Both Botnia and ENCE will employ a form of the AST process, commonly referred to as "extended

aeration". A design-based review and analysis of the major equipment to be used in the mills for wastewater treatment was made as part of this CIS evaluation. It was found that Botnia and ENCE will implement the IPPC-BAT (2001) recommendations for biological treatment. Since both companies will implement state-of-the-art effluent treatment plants, and discharge into the Río Uruguay where the impact from marginal additional reduction in color and nutrients is likely to be insignificant, tertiary treatment was not considered necessary in either case. For more detailed information see Sections 2.5, 2.7 and 4.6 of Main Report and Annexes A and D.

ENVIRONMENTAL AND SOCIAL SETTING

Land Use

The western Uruguay region is characterized by gently rolling terrain primarily in agricultural use. Farms tend to be large and agricultural production is a mix of cattle grazing, corn and soy production, and forest plantations (in descending order of importance). Nearly 38% of the total land area of Paysandú, Río Negro and Soriano is dedicated to agriculture and 70% of all agricultural operations in the three departments involve dairy, beef cattle and sheep ranching. Approximately half of all agricultural operations in each of the departments constitute 100 ha or more.

There are areas of natural tree growth in the landscape, usually in floodplains or low-lying areas (gallery forest), but such natural areas are mostly open-canopy, low-growing, deciduous forests that have been modified by grazing activity over the centuries since initial colonization. There are no designated protected natural areas in the immediate vicinity of the pulp mills.

The primary road network in the Fray Bentos and Paysandú area is paved with improvements still occurring in some areas. Many of the secondary roads are paved, and tertiary roads have gravel surfaces. The closest established recreational area to the project sites is Playa Ubici, on the east side of Fray Bentos, within view from the Botnia project site. There are other recreational sites within and south of Fray Bentos; all are out of view of the proposed Botnia mill.

Water and Aquatic Resources

The Río Uruguay is, after the Río Paraná, the most important river draining to the Río de la Plata. The watershed for the Río Uruguay covers a surface area of approximately 365,000 km^2, of which 51% is in Brazil, 33.5% is in Argentina and 15.5 % is in Uruguay. The upper and middle reaches of the river above the Salto Grande Dam, are characterized as riverine environments with relatively narrow channel width (less than 0.5 km), steep channel slope and various rapids. The lower reaches, within which the mills will be located, are characterized as estuarine environments with a relatively wide (1.8 km) and flat channel with numerous islands.

The average flow in the Río Uruguay at the Salto Grande dam is approximately 6,230 m^3/s, however, flows can vary substantially based on season, precipitation and operation of the dam. The monthly average flow varies from a minimum of 500 m^3/s to a maximum of 22,500 m^3/s over a 20-year period of record.

In general, the quality of water in the Río Uruguay is considered good but there are localized issues and exceedances of water quality criteria such as near Bella Union, Salto, Concordia, Paysandú and the mouth of the Río Gualeguaychú. This localized deterioration of water quality is primarily attributed to runoff from areas of intense agricultural use and discharges from urban centers and industries with inadequate effluent treatment. Contaminants which have been found to exceed guidelines include fecal coliforms, dissolved oxygen, ammonia, phosphorus, chromium, iron, zinc and phenols.

In general, sediment quality is also considered good but some nutrients and metals have been found to be elevated. Nitrogen and phosphorus concentrations are somewhat higher in the fall (April) as compared to summer months. In Yaguareté Bay in November and December, total phosphorus was 12 to 26 μg/g fresh weight (FW) of sediment, and nitrogen was 33 to 88 μg/g FW. Higher values of N in April were 38 and 416 μg/g FW, respectively. Also, locally high concentrations of chromium and copper have been found in sediments downstream of urban centres.

The lower Río Uruguay supports more than 100 fish species of which 17 species are captured regularly by the artisan fishermen of the area. The Uruguayan catch totals approximately 1,600 tons each year. Based on recent catch statistics, the most important species are sabalo, boga, mullet, tarira, dorado and various catfishes (pati, armed, yellow).

The benthic invertebrate community in some locations in the lower Río Uruguay is dominated by tubificid worms, midge larvae, or invasive mussels (golden mussel). Snails and clams were also common and were the dominant taxa in some samples. The tubificid worms are indicative of nutrient-enriched low oxygen conditions that many other species do not tolerate.

Low concentrations of contaminants in fish tissues in the vicinity of Fray Bentos include dioxins and furans, PCBs and organochlorine pesticides. All concentrations were below levels of concern for fish consumption.

Social Setting

The area of the CIS encompasses the eastern Uruguayan departments of Río Negro, Soriano and Paysandú as well as the Río Uruguay littoral in the Argentine department of Gualeguaychú. This entire area is characterized by a relatively homogeneous population concentrated in a small number of urban centers situated within a large agricultural area. The population is concentrated in urban areas, with almost nine out ten persons residing in cities or towns. The capital cities of Río Negro (Fray Bentos) and Soriano (Mercedes) account for about half of their respective departmental populations; three quarters of the

departmental population of Paysandú and Gualeguaychú, live in the capital cities, which carry the same name as the departments.

The age profile of the population is similar among all four departments with approximately half the population being 30 years or older. Population forecasts suggest very low rates of population growth and a relative decline in the rural population.

Table ES-2: Population and Population Density in Paysandú, Río Negro, Soriano and Gualeguaychú

Location	Area (km^2)	2004 Population (000)	Population Density (per km^2)
Uruguay	175,016	3,164	18.1
Paysandú	13,922	113	8.1
Río Negro	9,282	54	5.8
Soriano	9,008	85	9.4
Argentina	273,699	36,577	13.4
Gualeguaychú	7,086	101	14.3

Quality of life indicators, including rates of poverty, literacy, infant mortality, access to drinking water and sanitation, are relatively high in all four departments in comparison to other Latin American countries. While literacy rates are high in all departments (averaging 97.7%), only an average of 22.3% of the population fourteen years and older have completed primary school and only 20% have completed secondary school in the three Uruguayan departments. In Gualeguaychú, the comparable levels of population over 15 years of age having completed primary school is nearly 50%, and the percentage having completed secondary school is nearly 23%. Household income levels in these departments are somewhat lower than the average for Latin American countries as a whole.

Approximately 56% of the population of the three Uruguayan departments is economically active while 68% of the population in Gualeguaychú is economically active. There are large differences in unemployment between Río Negro and the other departments with the unemployment rate in Río Negro at 3.6% of the workforce, 16.3% in Paysandú, 16.9% in Soriano, and a significantly higher 27% reported for Gualeguaychú. The service sector is by far the most significant employer with an average of 70% of the active workforce employed in transportation, hotels and restaurants, banking, domestic service and retail trade. About 20% of the workforce is employed in the industrial sector (including manufacturing, construction and public utilities) and agriculture (farming, cattle ranching, forestry, hunting) accounts for the remaining 10%.

Between 11% and 32% of the population in the four departments are living at or below the poverty line with the lowest percent in Gualeguaychú and the highest in Paysandú. This assessment of poverty is based on a measure of the extent to which the population is

deprived of one or more basic needs including characteristics of housing, access to water and sanitation, access and achievement of education, dependency rate and other income-related indicators.

CUMULATIVE IMPACT ASSESSMENT

The cumulative impact assessments include the potential effects associated with existing projects and conditions, those of the proposed projects, and those of other developments that are realistically defined at the time the assessment is prepared and would impact directly on the project area. The timelines of the two proposed projects are offset by up to two years with Botnia currently under construction and ENCE not expected to commence construction until early in 2007.

Methodology

This study has employed specialized techniques and methodologies for the analysis of cumulative impacts such as computer modeling for the analysis of air emissions and effluents to water. Other methodologies used are generally quantitative to the extent that is feasible in the given discipline, while some are qualitative in nature and rely significantly on the judgment of the relevant expert(s) on the CIS technical team.

The assessment of air quality and related impacts of pulp mill emissions primarily involved mathematical modelling of atmospheric dispersion and the prediction of ground level ambient air quality for comparison to air quality criteria. Both meteorological and air dispersion models were employed. Meteorological models were used to augment the available meteorological data to provide a complete representation of the three-dimensional wind field within the general area of the mill sites. The assessment used the CALMET model coupled with a non-hydrostatic meso-scale weather forecast model referred to as FReSH. Air dispersion models were used to predict the change in ground level air quality attributed to the air emissions from the mill operations. Two air dispersion models were used for this assessment – the Industrial Source Complex Short Term version 3 (ISCST3) model and the CALPUFF model.

The assessment of water quality and related impacts of pulp mill effluents on the Río Uruguay primarily involved modelling of effluent dispersion in the river to determine resulting concentrations of effluent constituents for comparison to water quality guidelines and existing baseline concentrations. The assessment was supported by a literature review pertinent to some concerns, particularly dioxins and furans, endocrine disrupting compounds, and chemicals associated with fish tainting. The assessment of sediment quality impacts was based on consideration of the potential for change in water quality, including suspended sediment loads and on consideration of the conditions required for sediment mobilization.

Water quality modeling encompassed both the near-field and far-field environments relative to the discharge points. The CORMIX model developed by Cornell University was used as the primary near-field modelling tool. The far-field modeling was performed using the TABS-MD series of models, available from the U.S. Army Corps of Engineers. RMA-2 and RMA-10 are two- and three-dimensional finite element hydrodynamic models. RMA-2 computes the lateral and longitudinal distribution of water surface elevation and horizontal velocity, while RMA-10 includes the vertical distribution of velocity to enable assessment of stratified waterbodies. RMA-11 is a water quality sub-model capable of calculating the transport, dispersion and fate of water quality constituents, using the hydrodynamic results from RMA-2 or RMA-10. This modeling approach provides a comprehensive assessment of potential effects of the mill operation on the water quality of the Río Uruguay. The CIS project team has used this type of modeling approach to support environmental assessments of numerous other pulp mills and industrial facilities in North and South America.

Plantations

The Government of Uruguay has been supporting the development of plantation forestry for nearly twenty years. Subsidies and tax benefits are provided to encourage development of plantations in areas where the soils are classified as having a priority for tree plantations. This criterion ensured that soils with a high capability for cultivation under row crops or high quality pasture were not converted to other uses. Generally, this resulted in the conversion of less productive lands that had predominantly been used as rough pasture for cattle and sheep grazing.

Botnia and ENCE have their own plantation companies (Forestal Oriental, or FOSA, and EUFORES, respectively) with significant plantation holdings. Both companies also purchase wood from other plantation companies operated by Uruguayan third parties, under short or long-term contracts, as discussed further in Section 4.2.

During full production, 208,000 ha of eucalyptus plantations will be required to supply the mills (conservatively based on an eight year rotation and 25 m^3/ha/yr productivity). This breaks down to about 140,000 ha for Botnia and 68,000 ha for ENCE, although actual productivity achieved at Botnia's plantations reduces their requirements to about 125,000 ha. Production will be lower in the first two or three years and operations at the two mills will be offset by up to two years, reducing the required supply during the first rotation period to about 175,000 ha.

As of mid-2006, the combined land holdings of the two companies within the Littoral Region amounts to about 120,000 ha planted to eucalyptus. This accounts for at least 70% of the wood supply required by both mills within the first eight years of operation. Conservatively there is another 20,000 ha of plantations under third party ownership within the Littoral Region (based on the 2003 inventory prepared by the Dirección General Forestal). This number likely underestimates the third party holdings as additional plantations have been

added in the past three years. The companies have indicated that there are also 87,000 ha available to them from the departments of Tacuarembó, Durazno, and Florida which are within an economically viable distance from Fray Bentos. Not all third party contracts have been secured at this time, however the total existing plantation area owned by, and potentially available to, the companies exceeds the area required to supply both mills at full production. In addition, the companies own 40,000 ha in the Littoral Region that was not planted as of mid 2006 but is available for planting. Once planted, company direct land holdings will equal 77% of the full production requirements.

In general, most of the impacts resulting from the operation of existing plantations and the development of any new plantations were considered minor and manageable. All of the company-owned plantations and most of those owned by third party contractors are certified under the Forest Stewardship Council sustainable forest management program which requires assessment and audits of social and environmental impacts of plantations[1]. However, individual and cumulative impacts of potential significance may relate to water management issues – both surface water and groundwater. As such, the forestry companies supplying the two mills will continue their participation in on-going Uruguayan State University studies pertaining to impacts on soils, surface water, and groundwater.

Biodiversity

Uruguayan law prohibits the removal of natural forests or impacts to formally designated protected areas. As a result, the vast majority of lands converted to forest plantations have been converted from marginally productive areas that formerly supported mostly sheep and cattle grazing. Such areas may contain a greater diversity of individual species and gene pools than occur within the planted portion of eucalyptus plantations, but both areas largely contain exotic species.

As described further in Section 4.3, most of the plantations operated by the forestry companies owned by ENCE (EUFORES) and Botnia (FOSA) are managed under an agroforestry regime which often incorporates natural areas within a mix of land uses. On average 65% or so of these plantations are directly planted to eucalyptus with remaining areas used for cattle grazing, other agricultural activities, and natural areas. Plantations may not incorporate areas of natural forest, wetlands, and lands formally designated as protected areas. EUFORES and FOSA prepare management plans for the natural areas on their properties and undertake inventories and monitoring of flora and fauna.

Air Quality

Modeling of air dispersion and ground level ambient air quality were undertaken to determine the potential impact at ten locations of interest. The results were then compared to applicable standards and guidelines (Table ES-3) and used to estimate potential health and aesthetic effects. Air quality remains in compliance with ambient air quality criteria

[1] http://www.fsc.org/en/

under all meteorological conditions and operating conditions, and at all receptor locations. The CIS project team therefore concludes that there is no potential for human health effects associated with mill emissions.

Odour will not be detected during normal mill operations, but may be detected at locations near to the mills during mill upset conditions and during times of poor air dispersion. Operating experience at other modern mills indicates these occurrences will be limited to less than 10 times per year and to last for minutes to hours during the first year of operation, and for seconds to minutes thereafter. During these limited events, the odour at the nearest receptors (on and adjacent to the properties, Fray Bentos, Playa Ubici and the International Bridge) may be considered objectionable at times to someone with a sensitive sense of smell. At the beach resorts of Las Cañas, Uruguay, and Ñandubaysal, Argentina, odour, if detectable during these limited events, may not be distinguishable from odours experienced in daily life.

The air quality assessment is described in further detail in Section 4.4 of the main report and in Annex C.

Table ES-3: Summary of Potential Effects on Air Quality

Area on or adjacent to the mill properties	• Greatest potential change in ground based ambient air quality; • Air quality remains in compliance with ambient air quality criteria under all meteorological conditions and operating conditions, therefore limited potential for human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
City of Fray Bentos	• Air quality remains well below ambient air quality criteria under all meteorological conditions and operating conditions, therefore no adverse human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
City of Mercedes	• Immeasurable change in ambient air quality, well below any level that may cause any effect;
City of Nuevo Berlin	• Immeasurable change in ambient air quality, well below any level that may cause any effect;
Beach Resort of Las Cañas	• Air quality remains well below ambient air quality criteria, therefore no adverse human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, but at levels similar to that experienced in daily life (e.g., garbage, a poorly tuned car, a sewer).
Beach Area of Playa Ubici	• Air quality remains well below ambient air quality criteria, therefore no adverse human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
International Bridge, Uruguay	• Air quality remains well below ambient air quality criteria, therefore no adverse human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
City of Gualeguaychú, Argentina	• Immeasurable change in ambient air quality, well below any level that may cause any effect;
Beach Area at Ñandubaysal, Argentina	• Air quality remains well below ambient air quality criteria, therefore no adverse human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, but at levels similar to that experienced in daily life (e.g., garbage, a poorly tuned car, a sewer).
International Bridge, Argentina	• Air quality remains well below ambient air quality criteria, therefore no adverse human health effects associated with mill emissions; • Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.

The air monitoring programs recommended by ENCE and Botnia in their respective EIAs are considered largely satisfactory. It is recommended that monitoring of TRS be undertaken in Fray Bentos and at the international bridge.

Noise

Both Botnia and ENCE recognize the potential for noise impacts related to the construction and operation of their proposed pulp mill developments in Fray Bentos. ENCE also evaluated potentially elevated noise levels resulting from plant decommissioning and as a result of their plantation operations.

ENCE notes that noise impacts associated with all phases and operations are reversible and generally of low magnitude. Construction and decommissioning noise impacts are considered short-term whereas operational phase impacts are long-term and plantation noise impacts are long-term but intermittent. The highest noise levels are anticipated to occur during the plant construction phase due to the presence of many workers along with the movement of vehicles and heavy equipment. They estimate a worse case condition of 84.9 dB(A) at source but rapidly falling-off with distance, reaching a level of 45 dB(A) at about 500 m from the source. These latter levels would likely meet the IFC guidelines at the property boundary, however ENCE did not provide actual estimates based on the location of sources nor did they fully evaluate potential operational phase impacts. The location of the island across from the proposed mill would minimize impacts to human receptors in Argentina, however, there is not sufficient information provided to determine whether they will fully meet the IFC guidelines without further consideration of proposed mitigation measures. Mitigation measures proposed by ENCE to reduce the impact of elevated noise levels include the use of speed limits and signs to control vehicular traffic on-site and the planting of a vegetated border around the perimeter of the plant.

Maximum noise levels within plantation areas is estimated in the EIA as being in the order of 75 dB(A) due primarily to harvesting and handling machines. These levels would be confined to areas adjacent to the harvesting operations but, given the location of outer portions of the plantations relative to the property boundary, it is possible that the IFC guideline for residential receptors (45 dB(A)) would be exceeded for some adjacent properties and landowners for limited periods of time.

The Botnia EIA provides a range of potential noise levels during construction and operation from between 72 and 97 dB(A) near the source of sound emission, with short-term escalation up to 105 dB(A). They modeled the resulting noise levels at the property line and locations beyond, to show that the noise levels meet the IFC guidelines for the respective maximum allowable continuous equivalent levels. Mitigation measures for on- and off-site noise are noted as providing the workers with ear protection devices and notification of the local population when exceptionally loud noise will be anticipated during the construction phase.

ENCE should undertake detailed monitoring of noise levels adjacent to its mill and Botnia should implement monitoring at plantations as well as to continue to monitor around its plant site. Contingency plans should be prepared to protect particularly sensitive receptors in the event of exceedences of IFC guidelines. Overall, however noise levels resulting from the two projects are not expected to have a significant cumulative impact.

The noise assessment is described in further detail in Section 4.5 of the main.

Water Quality

Modeling of effluent flows and loadings were undertaken to determine the potential impact at eleven locations of interest. The results were then compared to applicable standards and guidelines (Table ES-4) and used to estimate potential impacts to human health, aesthetics, sediment quality, fish communities, and aquatic invertebrates. Since water quality is shown to remain in compliance with these standards at all receptor locations, the CIS project team concludes that there is no potential for human health, aesthetic or environmental effects associated with the mill discharges. Potential effects are limited to the area within the immediate vicinity of each diffuser where the effluent initially mixes with the ambient water. Beyond this small area, the water quality standards are achieved with the exception of those parameters which exceed the standards under present conditions due to the discharge of untreated municipal wastewater and agricultural runoff.

Botnia is considering the option of treating the municipal wastewater for Fray Bentos at its wastewater treatment plant. This will effectively eliminate a significant source of biochemical oxygen demand, phosphorus and bacteria to the beach area near Arroyo Fray Bentos, thereby improving the overall quality of the resource. The contribution of these respective water quality parameters (approximately 1.1 t/d, 0.03 t/d and 30,000 fecal coliform/100 mL) from the Fray Bentos are comparable to the source contribution from each of the mills. This is considered a significant benefit that should be considered further by DINAMA, the city of Fray Bentos, Botnia and other stakeholders.

Botnia is also considering the option of recovering the weak black liquor from the Papelera Mercedes (the Mercedes mill), which is a neutral sodium sulphite chemical (NSSC) mill and kraft mill located along the Río Negro in the community of Mercedes. The Mercedes mill does not have any form of chemical recovery or wastewater treatment, and all cooling and process waters are discharged directly to the Río Negro where it then flows to the Río Uruguay. Recovery of the weak black liquor by Botnia represents a significant environmental and social benefit. From an environmental perspective, the option results in a benefit to the Río Negro and Río Uruguay as it will reduce this source of potentially harmful chemicals discharged to these rivers (e.g., it will reduce the loadings of phosphorus and biochemical oxygen demand by 0.004 t/d and 7.8 t/d, respectively). From a social perspective, this option may ensure the economic viability of the Mercedes mill since the cost of treatment on-site is not viable for the small production capacity of the mill.

No impacts to sediment quality, the health of fish communities, nor aquatic invertebrates were found at the locations of interest with the exception of minor sediment nutrient enrichment and possible change in the benthic macroinvertebrate community within the vicinity of the discharges. This area is small (extending approximately 35 m from each diffuser and along its 200 m length) and therefore will not adversely affect the aquatic resources within the Río Uruguay.

The cumulative assessment of water quality in the Río Uruguay indicates that no water quality standards or guidelines will be exceeded as a result of the discharge of effluents from the two mills. However, chemical and biological monitoring in the river, in conjunction with mill effluent monitoring, is recommended to confirm lack of impact, or to serve as the basis for mitigative action if any unforeseen adverse impacts are discovered. A plume delineation study is also recommended, to be completed when the mills are operating normally.

The water quality assessment is described in further detail in Section 4.6 of the main report and in Annex D.

Table ES-4: Summary of Potential Effects on Water Quality

Vicinity of Botnia and ENCE Discharges	• Exposure Area extending approximately 35 m from each diffuser and 200 m along each diffuser. • Possible exceedance of surface water quality objectives within this exposure area during extreme low flow conditions (500 m^3/s). • Potential for aesthetic effect associated with visual detection of the effluent plume within a very small area at each diffuser during extreme low flow conditions.
Yaguareté Bay	• Water quality in compliance with DINAMA and CARU surface water quality standards (with the exception of phosphorus which exceeds the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality.
Playa Ubici	• Water quality in compliance with DINAMA and CARU surface water quality standards (with the exception of phosphorus and possibly bacteria which exceed the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality.
Fray Bentos Drinking Water Supply	• Water quality in compliance with DINAMA and CARU surface water quality standards (with the exception of phosphorus, ammonia and possibly bacteria which exceed the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality.
Beach Area near Arroyo Fray Bentos	• Water quality in compliance with DINAMA and CARU surface water quality standards (with the exception of phosphorus and possibly bacteria which exceed the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality. • Option to treat the municipal wastewater for the city of Fray Bentos at the Botnia mill will improve water quality within the beach area.
Beach Area near Las Cañas	• Potential for improved water quality if municipal wastewater for the city of Fray Bentos is treated at the Botnia mill.
Rio de la Plata	• Water quality unaffected.
Esteros de Farrapos e Islas del Rio Uruguay	• Water quality unaffected.
Rio Negro	• Potential improvement in water quality in Río Negro if untreated wastewater from Papelera Mercedes is treated at Botnia mill.
Rio Uruguay along the Argentina Side	• Water quality unaffected.
Beach Area at Ñandubaysal, Argentina	• Water quality unaffected.

Water and sediment quality monitoring programs are recommended, including upstream reference and downstream plume exposure locations. Water quality would be monitored bimonthly, for a comprehensive suite of chemical parameters. Sediment quality would be monitored every two to three years, for total organic carbon (TOC), grain size, pH, nitrogen, phosphorus, adsorbable organic halides (AOX), extractable organic halides (EOX), total phenolics, chlorophenolics, and dioxins and furans. This program will track any sediment nutrification effects, as well as any accumulation of toxic contaminants of concern. A comprehensive monitoring program is presented in Annex D.

Monitoring of benthic invertebrate community composition is recommended, concurrent with the sediment quality monitoring program. In addition, a selected benthic invertebrate would be collected for analysis of tissues for bioaccumulative substances, including chlorophenols, resin and fatty acids, phytosterols, and dioxins and furans.

Solid Waste

Best available techniques for solid waste management involve minimizing the generation of solid waste by recovering, recycling and reusing waste materials wherever practicable. These actions, as well as innovative waste minimization techniques, will be adopted by the mills. Solid wastes generated by kraft pulp mill operations generally consist of wood preparation waste; raw water treatment sludge; green liquor dregs, grit and lime mud; effluent treatment sludge; ash/sands; municipal solid waste; and minor quantities of hazardous waste including oily rags, spill collection wastes (chemicals and fuel), laboratory wastes, cleaning solvents, and used containers.

Both projects propose to construct on-site landfills for disposal of non-hazardous solid waste. In general, both landfill designs will consist of a low permeability soil or geocomposite bentonite liner over the compacted subgrade; an impermeable geomembrane (plastic) liner; and a leachate collection system consisting of high permeability material and perforated plastic piping. The leachate collection systems will divert leachate to the effluent treatment plants. The Botnia landfill has a design capacity of 19 years and the estimated capacity for the ENCE landfill is 30 years. There is sufficient space at both sites to extend the life span of these landfills as necessary.

The only potential organic waste going to an industrial landfill is the sludge from Botnia's river water treatment system. However, the organic content of the raw water treatment sludge is relatively small compared to the amount of inorganic waste going to the industrial landfill. In addition, the alkaline lime mud, grits and dregs are expected to inhibit biological gas generation within the landfills. If required, passive landfill gas venting systems can be installed to allow decomposition gases to vent to the atmosphere and avoid potential subsurface migration. Alternatively, these gases could be collected for combustion.

A groundwater monitoring system will be installed at each site and will consist of a network of upgradient and downgradient wells to monitor potential impacts and implement corrective

actions as appropriate. Each load of waste will be inspected, weighed and recorded to verify waste generation rates and determine if corrective measures are required.

Botnia has estimated that 100 to 150 tons of hazardous materials will be generated on an annual basis whereas ENCE estimates 80 to 100 tons per year of hazardous waste will be generated. Hazardous wastes generated at the facilities will consist of a variety of materials including but not limited to small quantities of used oils, solvents, detergents/cleaning compounds, certain building and maintenance chemicals, fluorescent light bulbs, and laboratory wastes. Both projects will transport these wastes to an appropriate off-site hazardous waste management facility. The companies should be prepared to monitor the type and amount of hazardous waste generated as well as ensure that an appropriate waste transportation tracking procedures are implemented.

Social and Economic

There is expected to be a significant increase in local employment opportunities, both direct and indirect, during the construction of the two plants and their subsequent operations. As a result, there is likely to be an influx of job seekers into the department of Río Negro. The socio-economic impacts of the two projects are considered from the perspective of direct and indirect effects on the regional and national economy as well as on social services and quality of life in the vicinity of the two plants. Given the current position of opposition to the mills by the Government of Argentina and the community of Gualeguaychú, it is expected that there will be negligible economic impact to Argentina in the near term. Should circumstances change, modest positive impacts may be realized based on employment opportunities from support services, and the potential for wood sales to the pulp mills.

The cumulative impacts of the two projects on the national and regional economy and on employment, as illustrated in Table ES-5, are likely to be significant in terms of economic performance, employment, balance of trade and tax revenue.

Both projects are expected to require 5,000 or more workers during their peak construction periods but these will not be required all at once since construction of Botnia's mill will be winding down as ENCE's ramps up. The increase in population during the three to four years required to construct both plants will be heavily weighted towards men, and in particular younger men. Both companies have discussed with community officials ways to mitigate and manage potential impacts of the influx of workers. Transportation will be provided from communities within commuting distance to encourage employees to remain in their home communities and not relocate to Fray Bentos. Housing integrated into the existing neighbourhoods in Fray Bentos, is provided for migrant workers and for workers with families. An agreement is in place with the government of Fray Bentos to acquire for its own use, the migrant worker housing once construction is complete.

The influx of labour will have some negative impacts to the community including a potential increase in traffic accidents due to reckless and alcohol-related behaviours, increase in

sexually transmitted diseases and pregnancy, shortage of rental properties and housing, and increased housing and rental costs. Also, the pace of life will increase with the influx of outsiders into the area; there will be an increase in traffic, with its attendant increase in noise; an increase in tourist and commercial activities; and a greater demand for and supply of cultural and recreation events and activities.

Table ES-5: Cumulative Economic and Employment Impact for the Orion and CMB Pulp Mills

Impact	Region	Construction Phase (2005-2007)	Operational Phase (Typical Year)
Economic (USD Millions)	Uruguay	417 (3.2% of 2004 GDP)	331 (2.5% of 2004 GDP)
	Rio Negro	206 (112% of 2003 GDP)	223 (121% of 2003 GDP)
	Soriano	33 (14% of 2003 GDP)	13 (6% of 2003 GDP)
	Paysandú	41 (13% of 2003 GDP)	23 (7% of 2003 GDP)
Employment (Person-Years)	Uruguay	18,699 (1.4% of 2004 Total)	12,593 (0.9% of 2004 Total)
	Rio Negro	11,196 (109% of labor force)	4,773 (47% of labor force)
	Soriano	1,337 (6% of labor force)	1,108 (5% of labor force)
	Paysandú	2,421 (8% of labor force)	2,048 (7% of labor force)
Balance of Trade (USD Millions)	Uruguay	- 1,100 (Similar to "normal" annual average)	+244 (Approx. 22% of "normal" trade deficit)
	Uruguay	+83 (2% of 2004 revenues)	+39 (1% of 2004 revenues)
	Rio Negro	-1.8 (19% of 2004 revenues)	+0.9 (10% of 2004 revenues)

Table ES-6: Estimated Employment Generated during the Construction and Operations Phases of both Pulp Mills (person years of full time employment)

	Construction Phase			Operations Phase		
	Botnia	ENCE	Total	Botnia	ENCE	Total
Direct	4,200	5,050	9,250	300	300	600
Indirect	5,710	6,866	12,576	3,976	2,094	6,070
Induced	2,512	3,020	5,532	3,879	2,043	5,922
Total	12,422	14,936	27,358	8,155	4,437	12,592

With the influx of population associated with both direct and indirect employment related to the pulp mill projects, there will likely be a temporary increase in the cost of goods and services. This increase will affect local residents living on fixed incomes or below the poverty line. However, local wages are expected to increase for the working population. These inflationary pressures are expected to be short-lived as the impact on the local economy passes and prices for goods and services stabilize. Long term benefits will also be experienced in the provision of additional public and private health care services and facilities.

Tourism, agriculture, fishing and apiculture are the principal natural resource-based activities in the area of the pulp mills. Such livelihoods are not likely to experience long term negative impacts as a result of the construction or operation of the two pulp mills as the need for new plantation areas to supply the mills will be minimal and the facilities will operate under Best Available Techniques, resulting in air and water emissions well below concentrations that are known to have any health effects.

A net benefit will result during the construction and, to a lesser extent, the operation phase, due to increased demand for agricultural, fishery, and apiculture products (milk, meat, vegetables, fish, honey, fruit etc). This increase in demand will benefit both the shop/ market owners primarily in Fray Bentos and farmers within the area of influence.

Tourism is well established in and around the area of the pulp mills. In Uruguay, the riverside beach at Las Cañas in the Rio Negro Department, and hot springs to the north of Paysandú province attracted more than 80,000 visitors in 2004 during the peak summer months of January to March. Approximately 80% of the tourists originate in Argentina.

Gualeguaychú in Argentina is also an important center of tourist activity attracting visitors to local beaches and the annual Carnival.

Effects on recreation will not likely occur as all discharges from the mills will comply with accepted air and water quality standards. Thus, visitors to the Las Cañas beach resort in Rio Negro and to Ñandubaysal beach resort in Gualeguaychú will not experience air quality, odour or water pollution impacts as a result of the pulp mills, and may, in the case of Las Caňas, realize an improvement. .

Botnia's plant will be a visible new feature in the landscape, especially for tourist traffic crossing the International Bridge en route to Las Cañas and other tourist destinations in Uruguay. The Botnia mill will also be slightly visible from Ñandubaysal, although from this location, the mill will not be a dominant visual presence any more than the existing buildings in Fray Bentos itself. ENCE's plant will also be visible from the bridge, but further away and less of a visual presence. The change to the landscape is permanent, however the public's response to these new industrial features is subjective and may evolve over time. Case studies have shown that tourism can co-exist with pulp mills and a few examples are identified in Annex E.

Monitoring programs of air and water emissions already planned by the companies will assist in future assessments of social impact mitigation. In addition, Botnia has commenced a detailed social monitoring program based on a number of indicators. The social and economic CIS assessment recommends that both companies co-operate in undertaking their monitoring programs. Specific monitoring program recommendations pertain to housing, policing, health care, education, employment, tourism, fishery resources, farm resources, and bee keeping. Generally, most of the monitoring is recommended for Fray Bentos, Río Negro, and Paysandú are on a quarterly, semi-annual, or annual basis.

Transportation

The transportation network in western Uruguay will be affected by the construction and operation of the Botnia and ENCE pulp mills. The two most important flows of traffic will be wood and other supplies delivered to the mills and pulp exported from the mills. In addition, there will be transport of personnel to and from the mills, and transport of domestic and hazardous waste to appropriate landfills.

The main modes of transport will be truck, barge or ship for wood and other supplies, and barge or ship for pulp. The operation of the two mills could result in a maximum of 650 additional barge trips per year on the Río Uruguay up to M'Bopicuá. This level of traffic would add an additional 1.8 barge trips per day to the existing 5.3 trips per day. Thus the increase in river traffic, when compared to traffic in 2004, will not be significant because the pulp export traffic will replace the current logs and wood chip volumes being exported or moved in river transport.

The impacts on the road network during construction of the two plants are not entirely additive since the construction for the Botnia mill will be winding down as construction for the ENCE mill will be gearing up. The impacts during the construction period that will be greatest in the immediate vicinity of each mill include a potential increase in road accidents, an increase in vehicular emissions, and increased demands for road maintenance. Both companies are developing management plans for road transportation in collaboration with the administration of the department of Río Negro.

The estimated annual average daily traffic (AADT) for the delivery of round wood to the Botnia mill is approximately 512, based on 256 daily return trips by truck on an annual basis between the mill and the surrounding forest plantations. The ENCE mill at full capacity will require approximately 137 return trips by truck per day, or an AADT of 274. These numbers imply a significant increase in truck traffic particularly on Highway 2 between the access road to the ENCE mill and the junction with the international bridge. There is a potential for congestion in this area, particularly at intersections. However, with the Botnia mill in place, wood transport to the port of Fray Bentos will be replaced by transport to the mill which will result in a significant decrease in truck traffic in the city itself.

The increase in truck traffic will require measures to control risks to pedestrians, including school children; the increase in truck traffic and traffic congestion can be minimized with dispatch systems that keep the trucks adequately spaced and also control speed; controlled spacing and continuously moving traffic should limit vehicle based air pollution; and the need for more frequent road maintenance will result in increased costs to the affected department governments. Compensation methods to increase maintenance funding could be developed to charge users for the increased costs, by installing tolls with appropriate rates for log haulers.

Energy

Most of the wood by-products that are not converted to marketable pulp fiber are burned in the pulp mills to produce energy. The burning of black liquor in recovery boilers at both mills will also produce steam and electricity and enable the recovery of cooking chemicals. A biomass boiler at the ENCE mill will produce energy by burning bark and wood waste from wood preparation and primary sludge from the effluent treatment system.

Electricity from the national grid will be used during start-up of production, regular maintenance and unplanned shutdowns (about 15 days per year). Fuel oil will be required for the boilers (for start-up, shutdown and unbalanced conditions), the lime kiln, the incinerator of odourous gases, and for emergency power. However, Botnia is expected to produce a surplus of 15 MW and ENCE is expected to generate a surplus of 31 MW. The combined total of 46 MW could be sold to the grid when both mills are in operation. This is equivalent to around 500 GWh of energy to the national grid per year and would represent around 5% of electricity generation in Uruguay.

The electricity sold by the pulp mills to the national grid can be called green power because it is produced using biomass which is a renewable resource. The power sold by the mills to the national electricity grid can be considered to have a positive impact if it offsets environmental impacts associated with production of electricity by thermal power plants in Uruguay, Brazil or Argentina. The amount of surplus energy that may be sold to the national electricity grid is equivalent to more than the amount of energy consumed as fuel oil at the Botnia mill.

The collection and burning of wood waste to generate electricity would also virtually eliminate the environmental impacts associated with incineration of wood waste in low-technology burners or decomposition of wood waste in landfills.

Regional Development

The companies and local communities are working together to develop social and environmental action plans that will increase local and regional development opportunities as well as community programs and activities. These should result in net benefits related to education, training, employment opportunities, and improvements to community infrastructures relating to health care, recreation, and utilities. Alternatively, quality of life

will be impacted both positively (increased wealth and services) and negatively (increased population, congestion, and demand for services). The companies are planning to institute a number of community communication actions to respond to problems as they may arise.

Environmental, Social, and Corporate Management Planning

Detailed environmental management plans are designed to cover all phases and activities of a development. Such plans are critical to ensuring that the results of the initial impact assessments are properly implemented and followed through with. They include specific actions to be taken with regard to on-going monitoring and responses to unplanned but predictable events; responsibilities and chain-of-command within the company; contact procedures (both in-plant and community, as required); staff actions to be taken (including both technical response and health and safety measures); reporting requirements; and follow-up. It is essential that such plans be kept up-to-date and they must be implemented via company policies which include staff orientation, education, and training (including simulations of events).

ENCE and Botnia are required to prepare environmental and social action plans (Plan de Acción Ambiental y Social – ESAP) as a requirement of their AAPs. These will cover both construction and operation phases and are subject to approval by DINAMA. The ESAPs will include a summary of corporate environmental policies and specific project management plans for a variety of activities. In February 2006, Botnia provided a schedule for the completion of their ESAP. It is recommended that all elements be completed by the time the mill commences operations. The components of Botnia's ESAP include:

- Integrated Management System for Environmental + Occupational Health & Safety issues and achieve certification to ISO 14001 + OHSAS 18001;
- Hazardous Material Management Plan;
- Emergency Response Plan to cover expected emergency events and impacts on plant and on the surrounding communities;
- Transportation Plan including road and river transport of wood and pulp all the way to the export terminal;
- Community Development Plan to guide future community based actions;
- strategy and detailed plan for conservation areas set aside;
- detailed design and operational procedures for the solid waste landfill;
- implementation of the groundwater monitoring program in FOSA owned plantation holdings; and
- demonstration that IFC's standards on environmental and social impact assessment, as well as on issues of occupational health and safety, are fully met at the site to be used primarily for pulp exports.

A social and environmental action plan was prepared by ENSE in 2006 (August 2). This document provides a summary of corporate management policies pertaining to environmental and social responsibilities and to health and safety. Specific plans within their ESAP include:

- Pollution Abatement and Prevention;
- Construction Management;
- Hazardous Materials Handling;
- Emergencies;
- Transportation;
- Community Development Plan;
- Natural Resource Conservation;
- Solid Waste Management;
- Hydrological Resources;
- Environmental Monitoring; and
- Public Communication and Consultation.

Public Disclosure of Performance Results

ENCE and Botnia are committed to ensuring that data pertaining to the operation and potential influence of the mills is readily available for public dissemination and is in a form that the lay public can understand. As required, all routine monitoring program data will be provided to DINAMA at which time the information will be in the public domain. The mills should also disseminate key performance data in a proactive manner. DINAMA has also required that each company participate in a "Follow-Up Committee" once operations have commenced. These committees will be presided over by MVOTMA, and will be made up of various governmental entities and representatives of the local communities. The committees will allow both the government and the local community to access information about the environmental impacts of the mills. In addition to the committees, the mills should use a public community centre in Fray Bentos, or similar mechanism, as a means to distribute information pertaining to effluent and air quality data as well as other environmental and health and safety information.

Effluent flow, COD, conductivity, and TRS data will be reported to the public to reflect daily operating performance. It is also proposed that acute toxicity data be reported to demonstrate the continued non-toxicity of the effluent. Along with the data itself, regulatory criteria (if applicable) and measures of "typical" mill performance will also be shown for comparative purposes.

Data relevant to the quality of the air and water receiving environment that is generated by the proposed routine monitoring will also be reported to the public in a timely manner. It is suggested that data for a few key water quality parameters (e.g., conductivity, dissolved oxygen, nutrients) be tracked and shown graphically as data permit for a subset of the proposed sampling stations such as for the stations upstream and downstream of the mill discharges, Yaguareté Bay, and the water intake for the City of Fray Bentos. Other routine monitoring data (fish, benthos) would be available on a regular but less frequent basis (as defined by the proposed schedule for each), and would be brought forward when available.

It is suggested that information tracking the environmental performance at the mills, and summarizing real time data that can provide stand-alone performance indicators, and which describes any major mill events that may have occurred be provided to surrounding communities on a quarterly basis. This should be done in hard copy via pro-active dissemination. The internet should also be used to distribute this information to help broaden public/stakeholder access and hardcopies (paper) and electronic copies of all receiving environment and effluent-related studies should be maintained in a catalogued library at the proposed public information centre in Fray Bentos.

1.0 INTRODUCTION

Two major European pulp producers have been developing pulp mill projects along the Río Uruguay near the city of Fray Bentos, Uruguay. Oy Metsä-Botnia Ab from Finland (Botnia), is developing the Orion project and Grupo Empresarial ENCE S.A. (ENCE), from Spain, is developing the Celulosas de M'Bopicuá (CMB) project. Both have prepared and publicly disclosed environmental and social assessments that describe the expected impacts of their projects and the mitigation and enhancement measures to manage those impacts.

To complete the assessment of the combined environmental and social impacts of the two proposed mills, IFC commissioned a Cumulative Impact Study (CIS) of the construction and operations of the two pulp mills and their respective raw material sourcing. The draft CIS was prepared by Pacific Consultants International and Malcolm Pirnie Incorporated and released in December 2005. Following a period of public review and professionally facilitated consultations in Argentina and Uruguay, the IFC commissioned a panel of independent experts to review existing project documentation and all comments provided by stakeholders. The results of this review are summarized in a report issued by the independent experts in April 2006. The report, referred to as the Hatfield Report, also identifies additional information and analysis required to complete the environmental assessment for the two mills.

EcoMetrix Incorporated (EcoMetrix) and its consultants, SENES Consultants Limited (SENES) and Processys Incorporated (Processys), revised the draft CIS in response to the recommendations of the Hatfield Report, the published Terms of Reference, original research and modeling conducted by the CIS project team, stakeholder commentary and other project related documentation.

The CIS was prepared on the assumption that both the Orion and CMB pulp mills were going to be located at already selected sites near Fray Bentos, Uruguay. On September 21, 2006, ENCE's President made a public announcement indicating the Company's intention to relocate its CMB pulp mill. Therefore, readers of this cumulative study, which was initiated 14 months prior to ENCE's announcement, should now view all references to cumulative impact on the environment of the region as being correspondingly less taking into account only the Orion pulp mill will be operating at the Fray Bentos location.

Uruguay's economy is characterized by an export-oriented agricultural sector, a well-educated workforce and high levels of social spending. Well into the 1980s, the economy was heavily dependent on livestock products and the vulnerability of this sectoral dependency was demonstrated when a two-year drought in 1988-1989 decimated the livelihood of livestock producers. In order to diversify the economy, and with the help of multilateral agencies, successive Uruguayan governments have promoted the development of the forest products sector over the past two decades. With the successful development of forest plantations to provide a supply of fiber, Uruguay is now encouraging the next step of domestic production of wood pulp.

Beginning in the mid-to-late 1980s, a number of studies were carried out to support the planning for the forestry sector development in Uruguay that is now unfolding. These studies were funded by several multilateral and bilateral funding agencies, including the World Bank, Japan International Cooperation Agency (JICA), Inter-American Development Bank (IADB), the US Export-Import Bank, and the US Overseas Private Investment Corporation (OPIC), among others. The World Bank provided funding for initial economic sector work and for technical assistance in developing forestry sector regulations, and continues to be involved in funding the Forest Products Transport Project. This ongoing project has been supporting significant improvements in, and maintenance of, primary and secondary roads used to deliver round wood and sawn wood from plantation areas to key ports such as Fray Bentos and Montevideo for export.

Two major European pulp producers are now developing pulp mill projects on the left bank of the Río Uruguay upstream near the city of Fray Bentos, the capital of the western Uruguayan department of Río Negro. Wood supply to the plants will be sourced primarily from plantations developed in western Uruguay for this purpose. Pulp will be exported by ocean-going freighter to paper producing plants in Europe, Asia and other regions.

Oy Metsä-Botnia Ab from Finland (Botnia), is developing the Orion project and Grupo Empresarial ENCE S.A. (ENCE), from Spain, is developing the Celulosas de M'Bopicuá (CMB) project. Both have prepared and publicly disclosed environmental and social assessments that describe the expected impacts of their projects and the mitigation and enhancement measures to manage those impacts. In addition to public consultations undertaken following the release of their assessments, both companies have ongoing programs to engage with their respective project's stakeholders.

1.1 Locations and Setting

Figure 1.1-1 shows the location of the projects within Uruguay and Figure 1.1-2 shows the relative location of each project with respect to Fray Bentos. The photographs in Figures 1.1-3a and 1.1-3b provide the development of the sites as of August 2006. Figure 1.1-4 provides an artist's illustration of the two proposed plants when fully operational.

The Botnia mill is located alongside the Río Uruguay approximately 5 km upstream (east) of the city of Fray Bentos on a greenfield site adjacent to the Uruguayan end of the Libertador General San Martin International Bridge that connects Argentina and Uruguay. The Río Uruguay forms the international boundary between Uruguay and Argentina in this region. As shown in the photograph in Figure 1.1-3a, the site is under development with the port, stack and civil structures near completion.

The ENCE mill is located approximately 11 km upstream (east) of the city of Fray Bentos on a site that currently contains a wood chipping plant and port facilities of the Terminal Logistica de M'Bopicuá (TLB), which were developed in 1998. The chipping plant converts whole or round logs that are trucked to the plant from surrounding eucalyptus and pine

plantations into wood chips, which are then exported for processing into pulp at offshore locations. As shown in the photograph in Figure 1.1-3b, the site is presently being prepared for construction.

Both mill sites are located adjacent to the Río Uruguay in predominately pastoral lands. The mills are visible from the international bridge, although the ENCE mill is less visible than the Botnia mill since it is further from the bridge and set-back further from the river. The stack for the Botnia mill is also visible from the beach resort of Ñandubaysal, Argentina, as shown in photograph in Figure 1.1-5. The photograph was taken in July 2006 when the mill stack was completely erected. The stack is visible on the skyline towards the right side of the photograph.

It will not be the first time in the history of Fray Bentos that a stack has acted as a land mark. A meat processing plant in Fray Bentos has had a stack for the past 100-years, and although it is not as obvious on the landscape as the new stack at the Botnia mill site, many residents of Fray Bentos value it as a reminder of the proud history of the meat processing industry in Fray Bentos. However, unlike the stack for the meat processing plant, the Botnia stack should not emit a visible plume, except for a white steam plume during cold, humid weather, as shown in the photograph in Figure 1.1-6. This photograph was taken in August, 2006, of an ENCE mill operation in Spain.

1.2 Overview of the Projects

Botnia and ENCE are each proposing to develop a bleached Kraft pulp mill designed to produce approximately 1,000,000 tons of air dried pulp on an annual basis (ADt/a) and 500,000 ADt/a, respectively.

Pulp is a processed fibre derived from wood that can be used for making paper and other products. The wood source for these projects will be established eucalyptus plantations within western and central-north Uruguay. The wood is processed by mechanical chipping, screening, cooking, bleaching and drying to separate the wood fibre from the water and lignin (natural glue that holds the fibre together in the wood) to produce pulp. The pulp will be exported to markets in Europe, Asia and other countries.

In addition to the pulp mills, the projects include infrastructure for the supply of raw materials, water and energy, and for the storage, transport and disposal of waste and primary and final materials. Overall, the projects include the following infrastructural components: the Orion and CMB bleach kraft pulp mills; the Kemira chemical plant; the existing port facility for the ENCE mill and a newly constructed port facility for the Botnia mill; mostly existing plantation areas within Uruguay; water intake and wastewater discharge structures within the Río Uruguay; and workers accommodation facilities within the neighboring city of Fray Bentos.

1.3 Economic Development

Uruguay is characterized by the Inter-American Development Bank as a stable democratic system, with sound public institutions, and having one of the highest degrees of legitimacy in the region (Inter-American Development Bank, IDB Country Strategy with Uruguay, 2005-2009). These characteristics are considered assets by which to attract foreign investment and to further economic growth.

The economy of Uruguay has evolved over the past half century. The Uruguayan economy reached 3.2% of the regional gross domestic product (GDP) during the 1950s, but consistently declined to 0.8% of the regional GDP by 2001. Proactive measures over the past several years have stimulated economic growth and the potential for recovery. To further its development, Uruguay identifies the need to: strengthen international integration; expand exports; increase investment; develop its natural and human resources; increase and improve the production and service sectors; incorporate increased value-added processing through technology; stimulate innovation; and increase employment. Uruguay also identifies the need to diversify its economy through further foreign trade and commercialization of products related to livestock and agriculture[1].

Forestry is becoming one of the most important and expansive sectors of the Uruguayan economy. In spite of a climate particularly favorable to the growth of forests, Uruguay has begun to develop its own forestry sector only in the last 20 years. Today, Uruguay is producing several million tons per year of wood, which is being exported to markets in Europe, Asia and other parts of the world. Since 2001, this economic base has broadened to include the industrialization of wood products by processing wood chips for export. This base is now being further expanded by the direct foreign investment by ENCE and Botnia to build and operate their first two pulp mills in Uruguay. These mills will process wood harvested from Uruguayan forest plantations into pulp for export.

These mills represent the largest foreign investment in the history of Uruguay, and are considered an integral part of the country's strategic objectives for economic recovery. The mills will provide economic benefit through investment and creation of jobs, both directly and indirectly. Other companies have already begun to invest in response to contracts for supplies and services with the mill proponents, and technological know-how is being transferred from foreign suppliers to the local industry[2].

[1] Affidavit of Martín Ponce de Léon, Undersecretary of the Ministry of Industry, Energy and Mining in the Government of the Republic of Uruguay, Observations of Uruguay, Exhibit 3, International Court of Justice, the Hague, 13 July 2006.

1.4 Regulatory Context

There is considerable evidence indicating that ensuring protection of the environment is a high priority for Uruguay[2]. The Constitution of Uruguay, particularly Article 47, recognizes water as a natural resource that is essential for life and is therefore to be protected, and recognizes access to drinking water as a fundamental human right. These principles are the foundation upon which all water protection laws in Uruguay are based. The Department of the Environment (Dirección Nacional de Medio Ambiente, DINAMA), as part of the Ministry of Housing, Territorial Planning, and Environment (i.e., Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, MVOTMA), is the agency directly responsible for the administration and enforcement of the environmental laws and regulations of Uruguay.

The specific laws and regulations are intended to ensure that industrial sources, including the ENCE and Botnia mills, do not cause unacceptable impacts to the water, air and other environmental media. They prohibit all facilities and activities from causing environmental harm, establish environmental standards for water bodies, and set forth detailed discharge limitations.

Specific laws also require project proponents to conduct an Environmental Impact Assessment (EIA) which describes the project, evaluates the potential environmental effects, and proposes monitoring plans and mitigation strategies. The mill proponents have submitted comprehensive EIAs for their respective projects. The EIA for the ENCE project was submitted to DINAMA on 08 January 2003 and, following review by DINAMA, was publicly released on 26 May 2003. A public hearing on the EIA was held in Fray Bentos on 21 July 2003. For the Botnia project, the EIA was submitted to DINAMA on 31 March 2004 with supplementary information and analysis provided on a range of topics including the cumulative impacts of the two mills in relation to water, air and odour. The EIA for the Botnia project was released to the public on 06 December 2004, and a public hearing was held in Fray Bentos on 21 December 2004. The consultation was announced in local newspapers and on radio and TV stations in the Fray Bentos area, including the adjacent towns, and efforts were made by the company to publicize the event across the river in the city of Gualeguaychú, Argentina.

Following DINAMA approval of the EIA, and after all Uruguayan conditions were met, the proponents were granted an initial environmental authorization" (Authorización Ambiental Previa (AAP)) for the project. The AAPs are an initial authorization for the mills. Separate authorizations are required for each phase of construction and before start-up of operations. The AAPs were granted by DINAMA on 09 October 2003 and 14 February

[2] Affidavit of Alicia Torres, National Director for the Environment, Department of the Environment (DINAMA), Ministry of Housing, Territorial Planning, and Environment (MVOTMA), Observations of Uruguay, Exhibit 1, International Court of Justice, the Hague, 2 June 2006.

2005 for ENCE and Botnia, respectively, in compliance with the regulation for environmental impact assessment (Reglamento de Evaluacion del Impacto Ambiental). The AAPs impose certain restrictions on the mills, specifically: compliance with all effluent limitations set forth in Uruguayan law (i.e., Decree 253/79); compliance with limits on other water quality parameters (e.g., AOX, nitrogen and nitrates); and compliance with the commitments made in their respective EIAs.

The AAPs also require the mills to comply with international surface water quality standards developed by the Administrative Commission of the Río Uruguay (Comision Administradora del Río Uruguay, CARU). These water quality standards are approved by the Governments of Argentina and Uruguay and are considered by these Governments as acceptable and adequately protective of the aquatic environment of the Río Uruguay.

For the construction and operation phases, the project proponents are required to submit detailed Environmental Management Plans (Plan de Gestión Ambiental, PGA) identifying the specific means by which negative environmental impacts will be avoided, and including plans for: mitigation and compensation measures; monitoring and reporting; prevention of accidents; emergency response; and abandonment. Additional requirements and safeguards may be stipulated by DINAMA at this time. To date, ENCE has received authorization to commence earth movement to prepare the site for further construction of the mill and associated infrastructure, and Botnia has received authorization to construct the port, stack, concrete plant, foundations, bleached cellulose plant, wastewater treatment plant, and to operate the harbor terminal during the construction phase of the mill.

A separate authorization is required before operations can begin. The Environmental Authorization of Operation (Autorización Ambiental de Operación, AAO) will only be issued after construction is complete and a compliance monitoring plan has been submitted and approved. To ensure that operating standards and procedures continue to be compliant with BAT and any revisions in Uruguayan regulatory requirements, the mills must request a renewal of their AAO every three years. Furthermore, at each renewal, Decree 349/005 empowers DINAMA to impose additional protective conditions on the project proponent, if additional requirements and safeguards are considered necessary.

1.5 Opposition to the Pulp Mills

Argentina and Uruguay have formally shared the management of the Río Uruguay since 1975. However, the conflict between the two countries concerning the pulp mills has affected diplomatic relations, transportation, trade and tourism between two countries that have shared a long history of amicable relations. Opponents of the two pulp mills on both sides of the river are concerned that the pulp mills will harm human health, the environment and the region's economy. Opposition by Argentines has included blocking routes to International Bridges, with the longest blockade lasting 45 days during the summer holiday season of 2005/2006.

In addition, numerous smaller demonstrations in Gualeguaychu, legal actions against the companies in Argentine courts as well as two very large demonstrations involving many thousands of primarily Argentine residents took place in April of 2005 and 2006 on the international bridge. Other manifestations of Argentine opposition have included a complaint filed with the Compliance Advisor/Ombudsman of IFC and MIGA, a number of letters to World Bank Group officials requesting suspension of consideration of pending loans, and putting pressure on potential financial supporters of the projects including export credit agencies and commercial banks.

On May 4, 2006, Argentina filed an Application initiating proceedings before the International Court of Justice (ICJ) against Uruguay claiming that Uruguay breached its duty under the 1975 Statute of the Río Uruguay to consult with Argentina before authorizing the construction of two pulp mill projects on the Uruguayan side of the Río Uruguay. Argentina's Application to the Court was accompanied by a request for the indication of provisional measures in the form of an Order that, pending the Court's final judgment, Uruguay suspend forthwith all authorizations for the construction of the two paper mills, take all necessary measures to suspend all construction work, and cooperate with Argentina to protect and preserve the aquatic environment of the Río Uruguay. On July 13, 2006, the ICJ issued an Order rejecting Argentina's request for provisional measures. The ICJ was not persuaded, based on "the circumstances as they now present themselves to the Court," that the construction of the mills presents irreparable damage to the aquatic environment of the Río Uruguay, or that the threat of any pollution is imminent. However, the Court noted that the mills are not yet operational and made clear that by proceeding with the work Uruguay "necessarily bears all risks relating to any finding on the merits that the Court might later make" and that the construction of the mills at the current site cannot be deemed to create a fait accompli. The Court also noted that its decision "leaves unaffected the right of Argentina to submit in the future a fresh request for the indication of provisional measures" based on new facts.

1.6 The Cumulative Impact Assessment

The International Finance Corporation of the World Bank Group (IFC) is currently assessing the two pulp mill projects in Uruguay for financing. In addition, the Multilateral Investment Guarantee Agency (MIGA) is evaluating whether to provide political risk insurance to the Botnia mill.

To complete the assessment of the combined environmental and social impacts of the two proposed mills, IFC commissioned a Cumulative Impact Study (CIS) of the construction and operations of the two pulp mills and their respective raw material sourcing. The draft CIS was prepared by Pacific Consultants International and Malcolm Pirnie Incorporated and released in December 2005. Following a period of public review and professionally facilitated consultations in Argentina and Uruguay, IFC commissioned a panel of independent experts to review existing project documentation and all comments provided by stakeholders, including the Argentine Government. The results of this review are

summarized in a report issued by the independent experts in April 2006 and are available in Annex H. In particular, the experts corroborated many of the issues and lack of sufficient information and analysis identified by stakeholders and the Argentine Government into their report and findings. The report, referred to as the Hatfield Report, also identifies additional information and analysis required to complete the environmental assessment for the two mills. Table 1.8-1 provides cross references to where issues and findings raised by the independent experts are addressed within the CIS.

EcoMetrix Incorporated (EcoMetrix) and its consultants, SENES Consultants Limited (SENES) and Processys Incorporated (Processys), revised the draft CIS in response to the recommendations of the Hatfield Report, the published Terms of Reference, original research and modeling conducted by the CIS project team, stakeholder commentary and other project related documentation. This report specifically addresses the following:

- Project Description – describes each project, including a description of: wood supply; project features; plant site selection; the Kraft process; ECF bleaching processes; emission and effluent characteristics; and project schedule and timelines;

- Environmental and Social Setting – presents an overview of the land features, air environment, aquatic environment and social setting to provide context for the project and a basis to assess potential change in the environmental and social state due to the proposed projects;

- Cumulative Impact Assessment – provides a detailed discussion of the potential change to the physical, biochemical and social environment resulting from the two projects; and

- Cumulative Impact Management – provides the management plan for the two projects, including monitoring and reporting.

The CIS report is supported by a series of accompanying annexes that provide further information to support the assessment of cumulative effects. These annexes include the following:

- Annex A, Process Technologies – describes the process technologies for each mill and examines whether the mills are being designed using best available techniques;

- Annex B, Plantation – provides information regarding the adequacy of wood supply for the two mills and assesses the social and environmental effects of the plantation;

- Annex C, Air Quality Assessment – provides an assessment of the potential change in air quality within the neighbouring areas of Argentina and Uruguay resulting from the mill operations and compares the results to ambient air quality standards and odour detection thresholds;

- Annex D, Water Quality Assessment – provides an assessment of the potential change in water quality within the Río Uruguay and assessment of the potential effect on aquatic life and environmental quality;

- Annex E, Socio-Economic Assessment – provides base-line socio-economic and demographic information, an assessment of possible social impacts (e.g., health, education, housing, quality of life and public security), and a monitoring program;

- Annex F, Transportation – provides an assessment of how the road network and Rio Uruguay will be affected by the transport of wood and pulp for the mills;

- Annex G, Public Engagement – provides the stakeholder assessment prepared by Consensus Building Institute (CBI) in December 2005;

- Annex H, Terms of Reference – presents the published terms of reference for the draft and revised CIS report, and a copy of the Hatfield Report;

- Annex I, Glossary – presents a glossary of technical terms used throughout the CIS report and annexes.

1.7 Project Team

The CIS report was prepared by a diverse team of specialists as outlined in Table 1.7-1.

1.8 Cross Reference to the Hatfield Report

The issues identified in the Hatfield Report are cross referenced to the CIS report and accompanying annexes in Table 1.8-1. The Hatfield Report is provided in Annex H.

Table 1.7-1: Project Team

Company / Personnel	Title / Other Role
EcoMetrix Incorporated	
Bruce Rodgers, M.Sc., P.Eng.	Project Manager; Aquatic assessment
Don Hart, Ph.D.	Senior Advisor; Aquatic assessment
Dean Fitzgerald, Ph.D.	Specialist; Aquatic assessment
Brian Fraser, M.Sc.	Specialist; Aquatic assessment
Janeen Tang, M.E.S.	Project coordinator
Processys Incorporated	
Paul Stuart, Ph.D., P.Eng.	Senior Advisor; Process technology
Peter Gleadow, B.Eng.	Specialist; Process technology
Jean-Martin Brault, M.Sc.	Specialist; Process technology
SENES Consultants Limited	
James Young, Ph.D.	Senior Advisor; Air quality assessment
Gwen Brice, B.Sc.	Senior Advisor; Socio-economic assessment
Michael Sills, Ph.D.	Project coordinator
Rich Urbanski, M.B.A.	Specialist; Air quality assessment
Dan Hrebenyk, M.Sc.	Specialist; Air quality assessment
Zivorad R. Radonjic, B.Sc.	Specialist; Environmental meteorology
Ana Luisa Covarrubias, M.Eng., M.B.A.	Specialist; Economic assessment
Harriet Phillips, Ph.D.	Specialist; Human health assessment
Independent Consultants	
Ismael Piedra Cueva, Ph.D.	Senior Advisor; Hydrodynamic model
Mónica Fosatti, M.Sc.	Specialist; Hydrodynamic model
Pieter Prange	Specialist; Plantation assessment
Daryl Cowell, M.Sc.	Specialist; Plantation assessment

Table 1.8-1: Cross Reference to the Hatfield Report

Issues Identified in the Hatfield Report (see Annex H)		Cross Reference to Sections Headings in CIS Report		Annex
A1	general lack of information	2.5	Bleached eucalyptus kraft pulp mill processes	A
A2	verification of discharge estimate	2.7	Evaluation of Emissions and Effluents	A
A3	comparison of mills with BAT	2.5	Bleached eucalyptus kraft pulp mill processes	A
A4	effluent treatment	2.5	Bleached eucalyptus kraft pulp mill processes	A
A5	effluent dioxin and furan	2.7	Evaluation of Emissions and Effluents	A, D
A6	minor factual inaccuracies	2.7	Evaluation of Emissions and Effluents	A
A6	minor factual inaccuracies	4.2	Plantations	B
A7	reference to European standards	2.7	Evaluation of Emissions and Effluents	A
A8	public criticism of air modeling	4.4	Air quality impacts	C
A9	expert's criticism atmospheric emissions modeling	4.4	Air quality impacts	C
A10	air quality - Argentina	4.4	Air quality impacts	C
A11	overview river water quality/aquatic resources	3.2	Overview of the Aquatic Environment	D
A12	the bay downstream of the Orion mill	4.6	Water quality impacts	D
A13	Fray Bentos water intake	4.6	Water quality impacts	D
A14	effluent and endocrine disrupting compounds	4.6	Water quality impacts	D
A15	effluent dioxin/furan and fish tissue	4.6	Water quality impacts	D
A16	effluent plume dispersion	4.6	Water quality impacts	D
A17	Tourism	4.9	Tourism	E
A18	plantation - biodiversity	4.3	Biodiversity and Natural Habitats	B
A19	plantation - water management	4.3	Biodiversity and Natural Habitats	B
A20	elemental chlorine free versus totally chlorine free	2.6	ECF vs. TCF Bleaching Processes	A
A21	fish tainting	4.6	Water quality impacts	D
A22	effluent color and pH	4.6	Water quality impacts	D
A23	mill site selection	2.3	Selection of Mill Sites	A
B1	Monitoring of wastewater effluent discharge	5.1	Environmental and Social Monitoring	A, D
B2	Air monitoring	5.1	Environmental and Social Monitoring	A, C
B3	Confirmation studies on plume modeling	5.1	Environmental and Social Monitoring	D
B4	Toxicity-free effluent	5.1	Environmental and Social Monitoring	D
B5	Health impact		Annex C	C
B6	Health standards for sulfur dioxide		Annex C	C
B7	Regional energy balance	4.11	Energy	A
B8	Wood waste incineration	4.4	Air quality impacts	A
B9	Treatment of Fray Bentos municipal sewage	4.6	Water quality impacts	D
B10	Effluent/atmospheric discharges in a local context	2.7	Evaluation of Emissions and Effluents	A, C, D
B11	Effluent and atmospheric emission limits	5.1	Environmental and Social Monitoring	A
B12	Continuous monitoring of environmental parameters	5.1	Environmental and Social Monitoring	A
B13	Regular monitoring of effluents	5.1	Environmental and Social Monitoring	A
B14	Public access to information on mill discharge	5.3	Public disclosure	D
B15	Operating procedures and training	5.2	Environmental, social corporate management	-
C1	Recycling alkaline effluent from the bleach plant	2.5	Bleached eucalyptus kraft pulp mill processes	A
C2	BAT and Eucalyptus pulp mills	2.5	Bleached eucalyptus kraft pulp mill processes	A
C3	Incineration of high-volume low-concentration	2.5	Bleached eucalyptus kraft pulp mill processes	A

Table 1.8-1: Cross Reference to the Hatfield Report (cont'd)

Issues Identified in the Hatfield Report (see Annex H)		Cross Reference to Sections Headings in CIS Report		Annex
C4	Oxygen delignification	2.5	Bleached eucalyptus kraft pulp mill processes	A
C5	ECF bleaching with low AOX	2.5	Bleached eucalyptus kraft pulp mill processes	A
C6	"Low odor" design recovery boiler	2.5	Bleached eucalyptus kraft pulp mill processes	A
C7	Tanks to contain spills	2.5	Bleached eucalyptus kraft pulp mill processes	A
C8	Biological effluent treatment	2.5	Bleached eucalyptus kraft pulp mill processes	A
C9	Life of plants versus landfills	2.5	Bleached eucalyptus kraft pulp mill processes	A
C10	BAT 2006 - Effluent flows	2.5	Bleached eucalyptus kraft pulp mill processes	A
C11	BAT 2006 - Partial replacement of chlorine dioxide	2.5	Bleached eucalyptus kraft pulp mill processes	A
C12	Overly conservative estimates of discharges	2.5	Bleached eucalyptus kraft pulp mill processes	A

Figure 1.1-1: Map of Uruguay Showing Project Location

Figure 1.1-2: Location of Projects

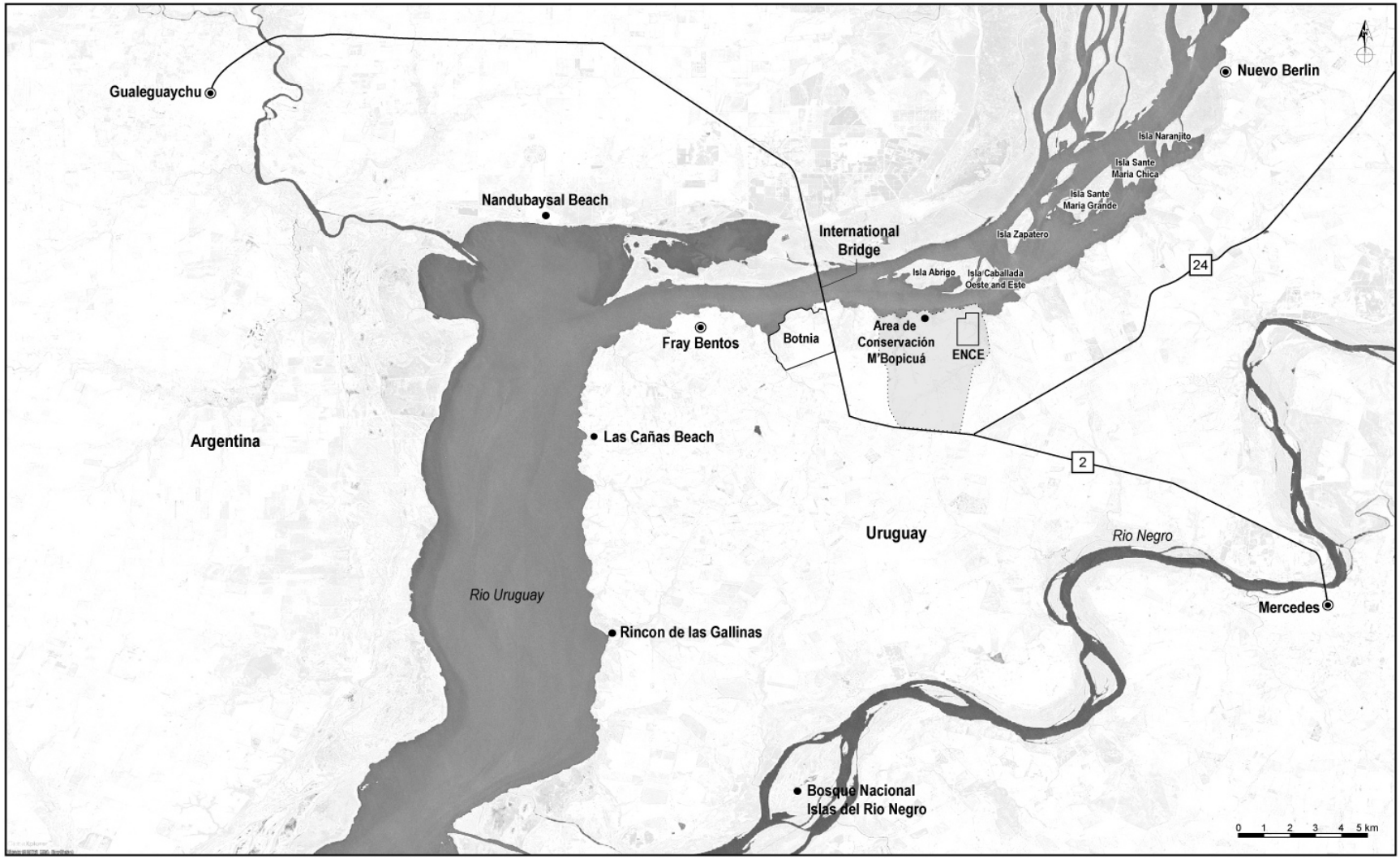


Figure 1.1-3a: The Botnia Site, August 2006

Figure 1.1-3b: The ENCE Site, August 2006

Figure 1.1-4: Illustration of Final Aspect of the Botnia and ENCE Sites

Figure 1.1-5: Photograph from Ñandubaysal, Argentina, Showing Botnia Site in Distance

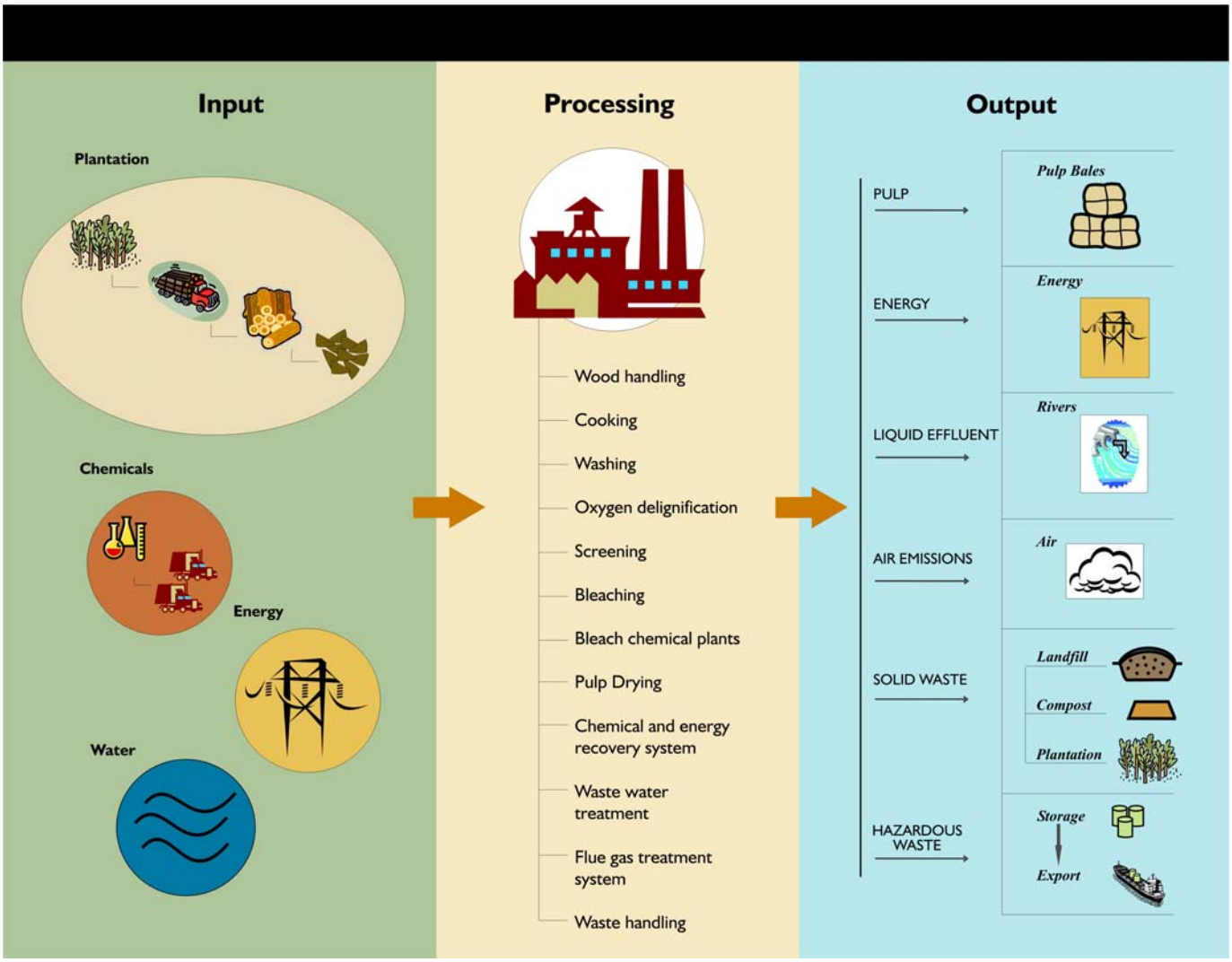
(photo taken with 36mm lens)

Figure 1.1-6: Example of ENCE Mill Operation in Spain

2.0 PROJECT DESCRIPTIONS

Botnia and ENCE are each proposing to develop a bleached Kraft pulp mill designed to produce 1,000,000 and 500,000 ADt/a, respectively. In addition to the pulp mills, the projects include infrastructure for the supply of raw materials, water and energy, and for the storage, transport and disposal of waste and primary and final materials. These project components are schematically represented in Figure 2.0-1, and are described in further detail in the following sections. Annex A, Process Technologies, and Annex B, Plantations, provide further detail on each project.

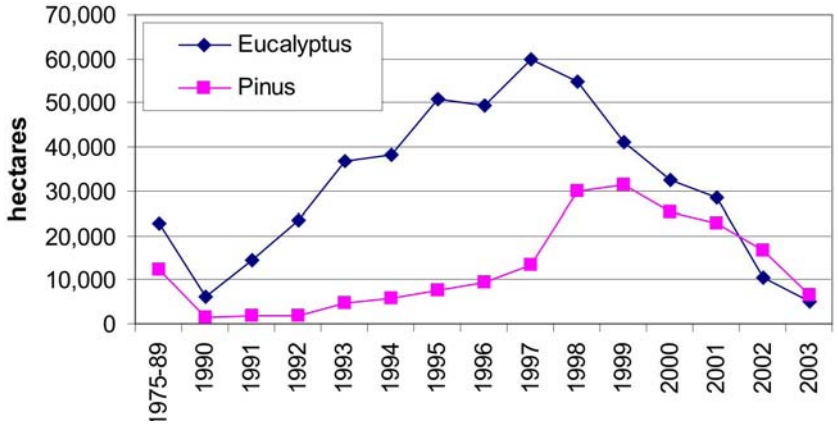
Figure 2.0-1: Schematic of the Pulp Mill Projects



2.1 Wood Supply

The two pulp mills are designed to produce pulp primarily from wood sourced from eucalyptus plantations that began to be established in Uruguay in the late 1980s in response to the Uruguayan Forestry Act of 1987. World Bank funding provided technical assistance to the Government of Uruguay in developing appropriate regulations for creating a higher value forestry industry to complement the existing agriculture and cattle ranching, and to develop a road network to facilitate the export of forest products. By the end of 2003, over 470,000 ha of suitable land for forest production were in eucalyptus production. Approximately 77% of the commercial forest plantations developed in Uruguay are subject to the Government's forestry promotion legislation, which requires each plantation operator to have an approved forest management plan. The wood supply for the two mills will come from company owned plantations and third party suppliers. All of the company owned plantations and most of the plantations owned by independent suppliers to the mills are certified through the Forest Stewardship Council's (FSC) sustainable forest management certification system[1].

Figure 2.1-1: Plantation Establishment in Uruguay 1975 to 2003



Source: Dirección Forestal

Establishment of new eucalyptus plantations peaked in Uruguay in 1997 at approximately 60,000 ha, but fell to an annual rate of less than 10,000 additional ha in 2003 (Figure 2.1-1).

As outlined in Annex B to this report, at full production, Botnia's plant will require 3.5 million m^3 of eucalyptus per year and ENCE's plant approximately 1.7 million m^3 for a total of 5.2 million m^3 per year. This production level will require approximately 17,500 ha/year[2]

[1] For more information, see: http://www.fsc.org/en/about/about_fsc/certification
[2] This is based on a conservative value for productivity (Annex B), however, Botnia's plantations have a higher productivity and they estimate that they will manage their supply on the basis of 12,500ha/yr of plantation area (T. Piilonen, Botnia, pers. comm. to Daryl Cowell, October 6, 2006).

and 8,500 ha/year, respectively of plantation area and a total of 208,000 ha over an eight year rotation cycle. Production will be lower in the first two to three years resulting in a requirement for 175,000ha of plantation area in the first eight years of operation. In the western and center-north areas of Uruguay, within convenient transportation distance of the pulp mills, are approximately 260,000 net ha of plantation. Both companies anticipate that supplies from their own lands, along with those from third party contractors will be sufficient to ensure adequate supply within an economically viable range for transport.

Figure 2.1-2 shows plantation areas in the region of Uruguay that will supply wood to the pulp plants. Short-term shortages resulting from unforeseen events and possible age/harvesting relationships in available plantations may generate demand for some sourcing of wood from Argentina. However, the economic viability of this imported fibre will depend on the relative price competitiveness of this wood given applicable taxes and tariffs at the time of export.

Both ENCE and Botnia are committed to ensuring that their own and associated supplier plantations are sustainably managed and do not have detrimental environmental and social impacts. The companies are requiring their suppliers to obtain independent certification of their forest management practices, through FSC certification. For more information on FSC certification standards see http://www.fsc.org.

There is increasing market pressure on international pulp producers to demonstrate that their product is sourced from environmentally and socially sustainable forests. In order for these companies to compete in the European market place, which is increasingly demanding a “green label” for forest products, manufacturers of those products need to ensure that their products are certified, and that this certification is maintained.

Both projects plan to transport wood from their respective plantations to their mills by truck. Branches and tree tops are not used in the pulping process and will be removed in the field and left for compost. The wood supply to the Botnia mill will also be removed of its bark for use as compost within the plantations. Any remaining wood fibre not useable for pulp will be burned in the bark boiler.

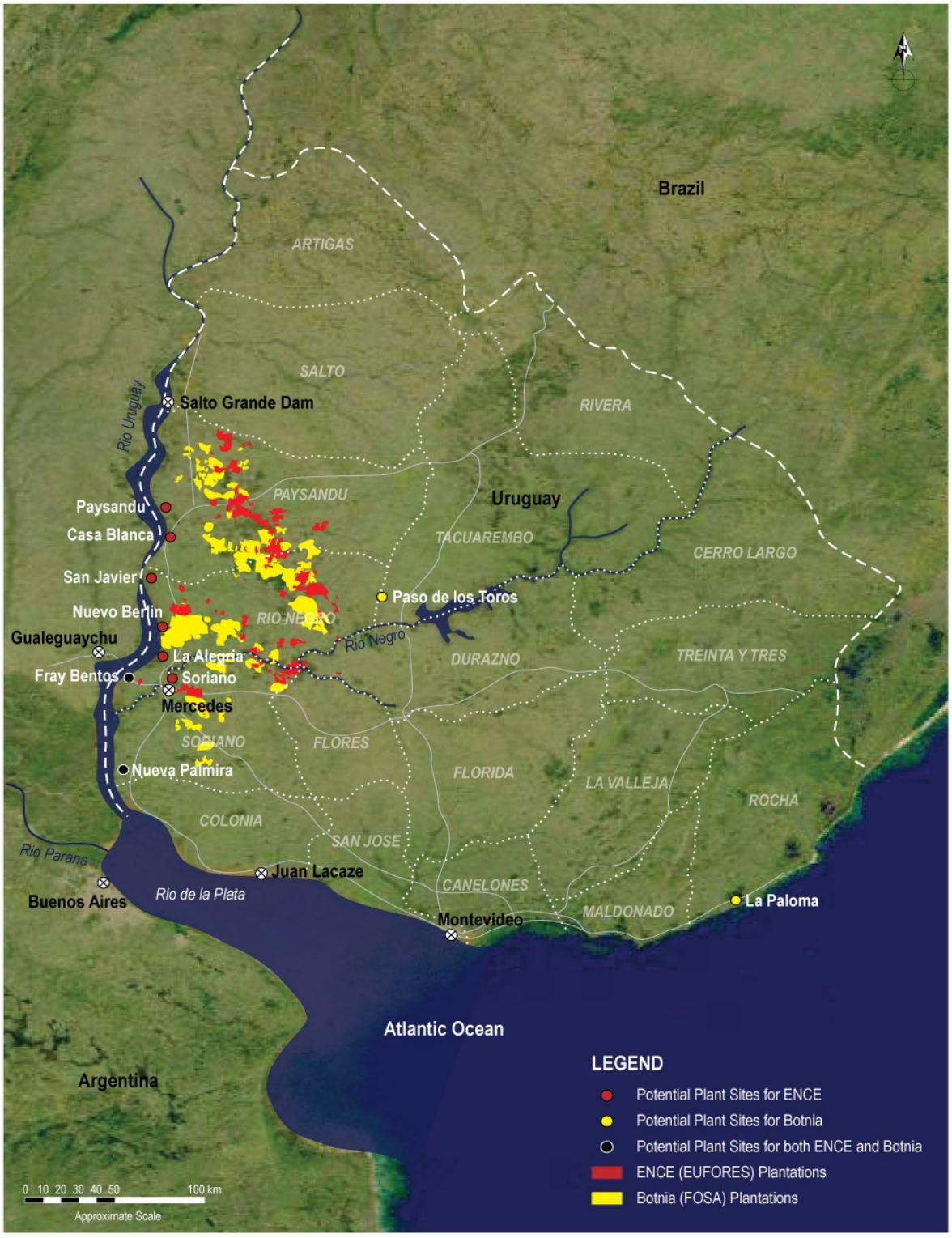
In addition, plant equipment and machinery as well as certain chemicals utilized in the plants’ operations will be brought to the sites by truck; others will come by barge (sea and river transport).

All of the pulp produced at both mills will be exported from Uruguay by ocean going vessels. Botnia is planning to first barge all of its pulp to the port at Nueva Palmira where it will be transferred into larger vessels. ENCE will partially load ocean going vessels at the Terminal Logistica de M’Bopicua (TLM) port facility adjacent to its proposed plant site and top them off at Montevideo port (which will receive the product by barge or truck).

An estimated 1.5 million tons of pulp (1 million tons produced by the Orion mill, 500,000 tons produced by the CMB mill) will be transported on the Río Uruguay from the two plants

combined each year. The amount of traffic required to move this tonnage will be nearly fully offset by the decrease in river traffic of pulp log and woodchip exports that are estimated to be of comparable volumes by the time the projects start operations.

Figure 2.1-2: Plantations Supplying the Projects



2.2 Project Features

The general features of the two projects are summarized in Table 2.2-1.

Table 2.2-1: General Features of the Projects

	BOTNIA - ORION	ENCE - CMB
Property surface area (hectares)	550	2,200
Project surface area (hectares)	80	55
Estimated investment (US$ million)	1,100	500
Annual Production (ADt/y) (tonnes of air-dried pulp per year)	1,000,000	500,000
First year in production (projected)	2007	2009
Service life (in years)	40	40
Wood consumption (millions of m^3/year)	3.5	1.7
Species	*Eucalyptus grandis* mainly and *Eucalyptus dunnii*. During first years, also *E. globulus* and *E. maidenii* will be processed.	During first 4 years, *Eucalyptus globulus* spp *globulus*, *maidenii* and *bicostata*, and *Eucalyptus grandis*. After this period, 100% *Eucalyptus globulus* will be processed.
Raw material transport (wood, fuel, chemical products, finished product)	Trucks, railroad, and/or cargo or barge. Project includes a harbor construction.	Road transportation of chemical products (to be defined). Chips are conveyed to silos by means of conveyor belts from M´Bopicuá Wood Park. Pulp shipment (on cargo) in the Terminal Logistica de M´Bopicuá.
Process water supply	Río Uruguay	Río Uruguay
Effluent receiver	Río Uruguay	Río Uruguay
Effluent volumes (per unit of production)		
Flow (m^3/ADt)	25	29
COD (kg/ADt)	8.0	8.7
BOD_5 (kg/ADt)	0.3	0.6
AOX (kg/ADt)	0.08	0.1
N (kg/ADt)	0.15	0.17
P (kg/ADt)	0.012	0.017
SS (kg/ADt)	0.7	0.9
Air emissions		
Particulate or dust (kg/ADt)	0.30	0.34
SO_2 (as S) (kg/t)	0.30	0.23
NO_x (kg/t)	1.35	1.3
TRS (kg/t)	0.05	0.03
Generated Power (MW)	119	72
Electrical Power consumption (MW)	104	41
Excess Power (MW) (with chemical production)	15	31
Power Boiler (biomass)	No	Yes
Brightness (% ISO)	89-92	91
Employment – peak construction period	4,200	5,050
Direct employment -- operations	300	300

2.3 Selection of Mill Sites

ENCE and Botnia decided to develop their pulp mills in Uruguay because of its forestry policy, natural resources, trained human resources, and social, political and economic stability. The government of Uruguay has promoted forestry plantations since the 1980s. The Forestry Act of 1987 (Law 15939) enabled large areas to be forested with fast growing commercially valuable eucalyptus and pine species by providing tax benefits and financial subsidies to companies that developed plantations within areas designated as "Forest Priority Soils". The afforestation program enabled agricultural diversification and provided employment opportunities in rural areas through the development of lands with poor agricultural productivity. The development of a competitive local wood processing industry was made possible by the large supply of wood resulting from the afforestation program.

The success of the afforestation program led to infrastructure improvements for transporting forestry products to ports for export. The Fray Bentos port was identified as a main corridor for transport of forestry products based on logistics, such as proximity to plantations. The investments in road, rail and port infrastructure were consistent with the government's objective of improving the economic potential of Uruguay's forestry products. Making wood chips and pulp are also consistent with Uruguay's economic objectives since they add value to forestry products and develop Uruguay's wood processing industry.

In 1985, a feasibility study for establishing a pulp mill in Uruguay was performed by the Japan International Cooperation Agency (JICA)[3]. Juan Lacaze (on the Río de la Plata), Fray Bentos, Casa Blanca (Paysandú) and Nueva Palmira were identified as potential plant sites. Shallow water depth around Juan Lacaze and Casa Blanca made these locations unsuitable for navigation of large cargo vessels. Frequent flooding was a concern for Casa Blanca. Distance from the afforestation area and lack of suitable industrial areas were identified as disadvantages for Juan Lacaze and Nueva Palmira. The planned industrial zone (west of the former Anglo meat processing plant), proximity to the afforestation area, no flooding, good conditions for ports, and good infrastructure (electricity, water, railway and road) were cited as advantages for Fray Bentos.

Site selection studies for the pulp mills were conducted in 1995 for ENCE[4] and in 2003 for Botnia[5]. The following summary of the site selection processes is based on the studies conducted by Jaakko Pöyry and additional information provided in the EIAs for the ENCE and Botnia mills. The plantation locations and potential plant sites for ENCE and Botnia are shown in Figure 2.1-2. Figure 1.1-1 shows the location of the selected project sites in their regional setting.

[3] Japan International Cooperation Agency (JICA). 1985. The Feasibility Study Report on the Establishment of a Paper Pulp Plant in the Oriental Republic of Uruguay.
[4] Jaakko Pöyry Consulting Oy. 1995. Empresa Nacional de Celulosas, S.A. (ENCE) Prefeasibility Study of a Pulp Mill in Uruguay.
[5] Jaakko Pöyry Consulting Oy. 2003. Project Orion. Selection of Macro Location.

The site selection processes for ENCE and Botnia included the consideration of logistical, infrastructural, social and environmental aspects. Proximity to existing plantation operations and relatively deep navigable waters were the most important logistical factors. Infrastructural aspects such as transportation (road, railway, port), power lines, housing and their services for personnel were taken into account. The social aspects considered included access to labour, industrial legacy, impact on existing livelihoods (e.g., tourism and fishing) and impacts on existing communities. The environmental aspects considered in the site selection process included water supply, waste assimilation, noise, aesthetics, air emissions, sensitive natural or cultural areas, and acceptance of the industry.

2.3.1 ENCE Site Selection Process

Macro-scale Considerations

For ENCE, the site selection process described by Jaakko Pöyry (1995) began with the identification of the western part of Uruguay as having the highest cutting potential and the Rio Uruguay as providing access to international markets. Eight locations along the Rio Uruguay were identified: Nueva Palmira, Soriano, Fray Bentos, La Alégria, Nueva Berlin, San Javier, Casa Blanca and Paysandú. In the preliminary screening, factors such as access to a deep water harbour, road and rail connections, and existing infrastructure were considered. This resulted in Nueva Palmira and Fray Bentos being identified as suitable for further evaluation. Although locations north of Fray Bentos had limited navigability for ocean-going vessels, Paysandú was included for the comparison of transportation costs.

The more detailed evaluation of Nueva Palmira, Fray Bentos and Paysandú showed that the overall costs for transporting wood and pulp were lowest in Fray Bentos. Wood transport costs were highest for Nueva Palmira while pulp transport costs were highest for Paysandú. Infrastructural aspects for Nueva Palmira and Fray Bentos were then evaluated. Nueva Palmira and Fray Bentos were considered to be equally good for aspects such as road connections, availability of industrial land, raw water intake and power supply. Fray Bentos was considered to be better for rail connections, housing and services (e.g., retail, medical, educational, recreational).

Micro-scale Considerations

Sites within Fray Bentos were evaluated based on environmental considerations such as noise, aesthetics, air emissions from vehicles, and potential accidental release of malodourous gases. The southern part of Fray Bentos town (the site of the former Anglo meat packing plant) was identified as a good harbour but was found to be less suitable than other locations because of its proximity to recreational and tourist areas (golf course and Las Cañas beach). The northern part of town was identified as having good road and rail connections and being adjacent to the municipal harbour, however its proximity to a residential area made it less suitable. Based on environmental factors, it was found that sites north of Fray Bentos (close to the international bridge) were most favourable. ENCE

decided to locate its plant a considerable distance from Fray Bentos. The selected plant site is shielded from the Argentine shore by a wooded island and surrounded by land owned by ENCE. The minimization of visual impacts from both the Argentine and Uruguayan sides was an important factor for ENCE during the site selection process.

2.3.2 Botnia Site Selection Process

Macro-scale Considerations

The Botnia site selection process described by Jaakko Pöyry (2003) evaluated four macro-locations (regions): La Paloma, Paso de los Toros, Nueva Palmira and Fray Bentos. The four regions were evaluated in terms of the following environmental issues: water supply, wastewater assimilation, possible conflict with other water uses, sensitive areas (for nature or recreation), and problems with acceptance of the industry.

- The limited amount of fresh water, the presence of important natural features for migrating birds, and the importance of the area for tourism reduced the suitability of the coastal region of La Paloma.

- The water supply for the Paso de los Toros region was considered to be sufficient for a major pulp mill. However, complications related to its location between two reservoirs made effluent dilution during low flow periods an issue for the Paso de los Toros region. Potential conflict with other water uses (i.e., agriculture, municipal potable water) and the need for infrastructure development were also identified, thereby reducing the suitability of this area.

- The Nueva Palmira and Fray Bentos regions are situated on the Río Uruguay, which would provide a good supply of fresh water. Important factors with respect to these locations were the guidelines to be established by CARU (Comisión Administradora del Río Uruguay) and that the area had already attracted the interest and concern of some environmental organizations focused on the impacts of plantation forestry and pulp mills. The potential for problems with the acceptability of the industry by the population of Fray Bentos was also identified based on the negative feedback provided by some members of the local population and NGOs to the ENCE project during the earlier DINAMA-led public hearing in Fray Bentos.

- The presence of two culturally important areas (Desembarco de los 33 Orientales; Obelisco 12 Oct 1880 and Bateria de Rivera 1841) and a high-end residential/recreational area (Carmelo) further discouraged the consideration of the Nueva Palmira region. Las Cañas and Ñandubaysal were identified in the Fray Bentos region. For both the Nueva Palmira and Fray Bentos regions, recreational areas would need to be considered when selecting the location of the mill. The need for infrastructure development in Nueva Palmira was identified.

Jaakko Pöyry (2003) conducted an analysis of the potential strengths, weaknesses, opportunities and threats (referred to as a SWOT analysis) for Paso de los Toros, Nueva Palmira and Fray Bentos. La Paloma was not included in the SWOT analysis because of the potential problems identified during the environmental evaluation. The SWOT analysis identified characteristics of the location that were positive and negative (strengths and weaknesses), as well as external factors that may be helpful or harmful (opportunities and threats). The potential strengths, weaknesses, opportunities and threats for each region that were identified in Jaakko Pöyry's analysis have been organized by topic and summarized in Table 2.3-1.

Table 2.3-1: Comparison of the Regions of Paso de Los Toros, Nueva Palmira and Fray Bentos for the Location of the Orion Mill (based on Jaakko Pöyry, 2003)

	Paso de los Toros	Nueva Palmira	Fray Bentos
Land for Mill Site	• low land price • good availability of land	• lack of suitable sites because of recreational areas	• potential to find a suitable area for mill • distance from sensitive areas
Plantations	• good availability of land for plantations • good growing conditions (potential "forest priority" areas) • need to relocate FOSA's plantations	• limited availability and high cost for plantations • plantations further away	• proximity to FOSA's plantations, as well as independent growers and Argentine growers • good conditions for growth of plantations • limited availability of land for new plantations
Transportation Logistics	• wood transport by truck, potential for train • pulp transport by railroad to Montevideo (potential rail link to mill) • long transport distance to Montevideo • lack of rail cars and locomotives (need to transport pulp by truck) • large storage capacity needed in Montevideo	• wood transport by trucks mainly, potential for barges • pulp transport by Rio Uruguay (ocean-going vessels, port in Nueva Palmira would need to be extended) • higher wood transportation cost and environmental impacts because of distance from plantations • no major union disputes foreseen at the port • good for transportation of chemicals and equipment • improvement of road between Fray Bentos and Nueva Palmira • poor road network in east west direction	• wood transport by trucks mainly, potential for train and barges • pulp transport by Rio Uruguay (dredging not completed so topping off and barging required, port in Nueva Palmira) • lowest transportation costs and impacts because of proximity to wood supply • potential cooperation with ENCE in port project • good connections to Argentina, Paysandu and Montevideo for access to goods and services • potential rail improvement from east • improvement of road between Fray Bentos and Nueva Palmira • poor road network in east west direction

	Paso de los Toros	Nueva Palmira	Fray Bentos
Labour and Infrastructure	• low population density • under-developed infrastructure • potential high costs for development	• near to most developed population areas • existing infrastructure	• technically skilled labour force • acceptable social infrastructure • industrial history
Energy		• existing electrical grid restricted	• 150 kV power line close to Fray Bentos • high-pressure gas pipeline on Argentine side
Water	• insufficient flow during the dry season for raw water supply and dilution of effluents	• ample supply of water	• ample supply of water • city water intake located downstream of mill
Acceptance of Industry		• potential objections by Argentina • possible objections by other provinces (Río Negro, Paysandu)	• potential objections by Argentina • opposition by users of recreation areas downstream • some negative attitude towards forestry industry based on a response to ENCE project
Other	• priority location for development in government's plan (potential financial support)	• tax-free zone • existing pulp and paper mills in south west	• further away from port in Montevideo (as backup)

Micro-scale Considerations

Based on logistics, environmental considerations and the SWOT analysis, the Fray Bentos region was selected. Botnia decided to locate its mill near the old industrial city of Fray Bentos because of its workforce and social services. Allowing people to live in a city instead of the rural areas was an important factor for Botnia. The use of modern technology to reduce environmental impacts now enables pulp mills to be safely located near cities and potentially sensitive cultural and tourist areas without significant adverse effects.

Various locations along the river bank near Fray Bentos were considered based on access to a sufficiently deep river channel near shore. The possible location upstream from the international bridge was already occupied by ENCE. Further north, the river is very shallow and closer to the conservation area, *Esteros de Farrapos e Islas del Río Uruguay*. The possible location downstream of the city of Fray Bentos was not considered to be suitable based on its proximity to the tourist areas of Las Cañas and Ñandubaysal and other recreational areas.

The location downstream of the international bridge was selected because potential dredging of the Río Uruguay in the future would allow the passage of ocean-going vessels. In addition, the location did not have significant natural features (mainly pastureland) and it was a large property on the river whose owners were willing to sell. Other positive characteristics included: road connections, proximity to the international bridge, potential railroad connections, national electric grid and substation (150 kV) nearby, and an elevation above flood level.

2.3.3 Summary of the Site Selection Processes

The key factors considered in the macro-scale site selection process included: location on the Río Uruguay (transportation, water supply and wastewater assimilation), proximity to eucalyptus plantations (wood transport costs and transportation impacts), and existing infrastructure (roads, electrical grid, educated workforce and services). Both companies decided to locate their pulp mills in Fray Bentos. It appears that logistical factors played a key role in the companies' decision making, however environmental and infrastructural aspects were also important. Challenges related to acceptance of the industry were identified by Botnia, however they seem to have been outweighed by the strengths of the Fray Bentos location and Botnia believed that an aggressive public outreach and information effort, along with the economic benefits to the community would ultimately lead to a strengthening of local support.

In their micro-scale site selection processes, distance from sensitive natural and cultural areas was an important consideration. Both companies decided not to locate their pulp mills near the old Anglo meat plant because of its proximity to recreational areas such as Las Cañas and Ñandubaysal. ENCE decided to minimize visual impacts by locating its site at a distance from urban areas. The options for Botnia were more limited because Botnia began its site selection process after ENCE was already established at M'Bopicua. Enabling people to live within the city instead of in the rural areas was an important consideration for Botnia in their micro-scale site selection process.

2.4 Ports

Ports at M'Bopicuá, Nueva Palmira, the Botnia mill and Montevideo will be used for the export/import of pulp and other supplies for the mills. Ports along the Río Uruguay have already experienced increased traffic because of increased log and woodchip exports. A brief description of each port, including environmental and social impacts, is provided below.

2.4.1 M'Bopicuá Port

The M'Bopicuá port is located about 11 km from the town of Fray Bentos, and 5.5 km upstream of the international bridge. It is situated on a secondary channel of the river, to the south of the Island of Horses and the Ñandubaysal step. The port in the city of Fray

Bentos was partially relieved of increased demand when the M'Bopicuá port was built in 1998.

The M'Bopicuá site contains a chipping plant for the export of Eucalyptus wood products. Other facilities on site include: storage esplanade, parking lots, access roads, wastewater treatment plant, pump house (fire prevention), wharf and sanitary landfill. Ships are loaded at the port and navigate along the main channel of the Río Uruguay. ENCE plans to partially load ocean vessels with pulp at this port and fill the remainder at the Montevideo port. Botnia does not plan to use the M'Bopicuá port.

The port is located on a natural bluff which is part of the Fray Bentos formation (sandstone rock formation). The site had limited agricultural potential and was used mostly for grazing. Prior to development, the site consisted mostly of a prairie ecosystem of native and exotic species that was partially removed for the port development. Two ecosystem types were preserved: remnant riverine forests along the river and creeks on the Uruguayan plain. There are three archaeological sites present at the port: the De Baja findings, *las ruinas del saladero de M'Bopicuá*, and M'Bopicuá Prehistoric Site.

Prior to approval and development of the M'Bopicuá port, numerous environmental, economic, and social studies were completed. The environmental studies examined the impacts during construction and operation, and included the topics of air quality, noise, flora and fauna, runoff, sedimentation, waste management, water quality (including potential for contamination), flow, morphology, fish habitat and health in the Rio Uruguay. The social and economic impact assessments for the construction and operation phases of the port included the topics of population, economic activities, employment, services, quality of life, traffic (terrestrial and marine), visual impact, indigenous populations, and archaeological and historical heritage.

The Environmental Impact Assessment by Constructora Santa Maria Ltd. outlined the main permanent positive and negative changes (environment, social) during the construction and operation of the port. During construction, the removal of vegetation, grading, quarry operation, and construction of roads and buildings were predicted to have an adverse permanent impact on soil, natural landscape, water quality, and natural drainage. The dredging and disposal of sediments were also predicted to negatively affect the benthic fauna of the river.

Benefits include the creation of a nature reserve and preservation of archaeological sites. The operation of the new wharf was expected to improve the regional transportation system (roads and waterways), stimulate the economy, and create new jobs. Potential changes to water quality, fish habitat, benthic macroinvertebrate community, and terrestrial fauna populations and habitat were identified.

ENCE's subsidiary, EUFORES, manages nature zones, old forest reserves, water-meadows and palm groves. Conservation areas and breeding areas for endangered

species have been established at M´Bopicuá and Santo Domingo. The Ecoschool program promotes environmental awareness by providing visits for school children to the conservation areas. These naturalized areas provide compensation for potential effects of the port development on terrestrial faunal populations and habitat.

2.4.2 Nueva Palmira Port

In 1956, the Nueva Palmira port was constructed at the terminal of the Paraná-Paraguay waterway (confluence of the Río Parana and Río Uruguay). Wood, grains, ore, sugar, salt, citrus fruit and fertilizers are shipped from this port. There are both state and private wharfs at the Nueva Palmira port.

Currently, Botnia plans to barge all its pulp to the Nueva Palmira port. The Nueva Palmira port is being expanded to accommodate Botnia's operations as well as those of other local industries. The port will have an esplanade of 55,000 m^2, a cellulose warehouse of 30,000 m^2 and dock 180 m long and 40 m wide to accommodate ocean-going vessels. Many of the same environmental and social impacts described for the construction and operation of M'Bopiqua port have been identified as issues for the expansion of the Nueva Palmira port. They include loss of biodiversity and natural habitat, potential change in water quality, loss of beach area, increase in fluvial traffic, job creation and an improved economy.

2.4.3 Port at Botnia Mill

Botnia has constructed a port at its mill site to transport pulp by barge to the Nueva Palmira port. At the Nueva Palmira port, the pulp will be transferred to ocean-going vessels. The port enables construction materials and chemicals for the mill to be shipped directly to the site.

The use of either the Fray Bentos or M'Bopicuá ports instead of construction of a new port at the Botnia mill was considered, however the use of an existing port was not selected due to concerns relating to the transport of chemicals and other materials between the mill and the off-site port facility. There were also concerns regarding traffic of ships and barges passing under the international bridge. These concerns could be moderated by reducing the distance traveled and the building of new, high standard handling facilities.

The size of the mill port was minimized to reduce impacts. The original design was for a port large enough to support ocean-going vessels with a dock structure similar to those of other major ports along the Río Uruguay. The port design and construction was discussed with DINAMA and design changes were made to take DINAMA's suggestions into account. Daily monitoring has shown that there have been no impacts to the water quality of the Río Uruguay during construction of the port.

The main issues associated with the construction and operation of the port included the loss of connectivity between spawning and rearing habitat, loss of habitat for the protected

river otter and vulnerable catfish species, and damage to terrestrial vegetation communities that contain rare species. Baseline fisheries studies revealed that on either side of the proposed port site are creek inlets which are rearing areas for local and migratory fish. They include the Las Cañas Creek, Los Perros Stream and the Yaguareté Creek inlet. Some local species, such as carp and catfish, likely spawn here, as in other shallow embayments up and down the river. These inlets are also feeding zones for the river otter (*Lutra longicaudis)*, and tracks of this species were found during mammal surveys.

The hydrodynamics of the Rio Uruguay were investigated by Botnia as part of their EIA to determine the potential effect of the port development on current velocities and sedimentation within Yaguareté Bay. Water velocities were found to be lower in Yaguareté Bay as compared to the main channel, and as such, sedimentation may occur more readily in the embayment than further offshore. However, the port development is not expected to significantly affect sedimentation within the embayment since periodic high flows and wave action is sufficient to prevent accumulation of sediment.

The location of the port was comprised of scrub and forest vegetation communities. Impacts on the terrestrial environment were identified relating to rare floral species. Some vegetation communities and species were recognized as ecologically or socially significant and conservation areas were recommended. The coastal forest contains tall (7 to 8 m) mature *Myrsine coriacea*, *Hexachlamys edulis* and *Sapium haematospermum* trees, and an old specimen of *Luehea divaricata* along the shore that is well loved by the citizens will be preserved (Botnia, 2004). Location and size of the port were adjusted according to the suggested area to be conserved. Before construction began, an archeological study was completed within the coastal and underwater areas. No artifacts of cultural or historical value were found. The river and creek water quality was also closely monitored during the port construction.

2.4.4 Fray Bentos Port

The Fray Bentos port is about 6 km downstream of the international bridge and is connected to a road and railway system. Products that go through the port include wood products, grain, and citrus fruit. It is expected that with the development of the pulp mills, the volume of wood products passing through this port will decrease, leaving port space available for other activities.

2.4.5 Montevideo Port

Montevideo's port is located in the Río de la Plata and originated pre-independence (1828). It is Uruguay's largest port and its extensive wharfs and facilities service many South American countries. Environmental and social impact studies are underway for a proposed addition of a new wharf.

The ENCE project intends to use this port. It plans to partially load ocean-going vessels with pulp at the M'Bopicuá port and top off the vessels in Montevideo with pulp shipped via barge, truck or rail. Botnia has no plans to use this port.

2.5 Bleached Eucalyptus Kraft Pulp (BEKP) Mill Processes

This section summarizes the technology to be implemented at the Botnia-Orion and ENCE-CMB bleached eucalyptus kraft pulp (BEKP) mills, highlights features that are pertinent to their environmental performance, and compares these features with the IPPC Best Available Technology (BAT) requirements related to emissions to water and air. Specifically for the kraft pulp sector, the IPPC-BAT (2001) systematically: a) reviews typical current processes and techniques implemented in the sector, b) summarizes the emissions from mills, and identifies environmental concerns, c) describes techniques for emission abatement, waste minimization and energy savings that should be considered in the determination of BAT emission levels, d) defines the range of emissions to water and air that result from the implementation of BAT, and e) discusses emerging techniques.

The Tasmanian-AMT (2004) and the USEPA Cluster Rule standards were also used in this CIS for reviewing the mills to further evaluate whether high design standards have been applied.

The kraft or sulphate process is the dominant pulping process worldwide, due to superior pulp strength properties, its applicability for most wood species, the ability to recover and reuse the main process chemicals and its energy efficiency. The main environmental concerns with kraft pulping include wastewater effluent, emissions to air including malodorous gases, the management of solid waste residuals, and energy consumption. The main raw materials for the process include wood fibre, water, energy, and chemicals for cooking and bleaching. The process consists of five main components: 1) wood handling; 2) pulping; 3) chemical recovery; 4) bleaching; and 5) pulp drying. These are described in the next section, followed by a discussion of BAT issues. Annex A of this report contains the detailed BAT analysis.

2.5.1 Mill Processes: Wood Handling and Biomass Management

Wood handling is the first step of the kraft process. In this step, logs are debarked and cut into manageable sizes.

At the Botnia-Orion pulp mill, logs will be dry-debarked at the plantations so that the residuals can be returned to the soil, and thus the debarking drums at the mill must remove only the remaining bark and impurities such as remnant soil and sand. Because the mill will use different eucalyptus species, there will be two separate chipping lines and storage. Bark residues and fines from screening will be returned to the plantations.

At the ENCE-CMB facility, two parallel wood preparation lines will be used. Eucalyptus logs arrive by truck with bark and are fed to a dry debarker and washed to remove sand, dirt and

other materials, prior to the chipper. Accepted chips will be sent to two storage silos while fines will be mixed with bark and burned in the woodwaste boiler. This boiler is designed to burn bark from debarking operations, as well as waste produced during subsequent wood processing. A bubbling fluidized bed (BFB) combustion technology will be employed. The primary sludge from the wastewater treatment plant as well as biosolids from wastewater treatment (when it cannot be burned in the recovery boiler), can also be burned in the biomass boiler. Ammonia injection will be used in order to minimize the discharge of NO_x from the biomass boiler. Flue gases leaving the boiler are cleaned in an electrostatic precipitator (ESP) before the gases are released to the atmosphere. Fly ash separated from the flue gases, as well as the bottom ash from the furnace, are taken to the landfill.

2.5.2 Mill Processes: Pulping

In the pulping digester wood chips are broken down into papermaking fibers by reacting with white liquor. Pulping at the Botnia-Orion mill will be done in a Downflow Lo-Solids® continuous digester. Brown stock pulp will be washed first in the digester, then in 3 high-efficiency drum displacement washers in parallel before oxygen delignification, and there will be two more washers in parallel after oxygen delignification and before bleaching. Washing efficiency is more than 99% and the open cycle wash losses are about 8kg COD/ADt. Brown stock screening will be done in a three-stage closed cycle system, with slotted pressure screens. Before bleaching, pulp will be delignified in a two-stage oxygen delignification unit, after which the kappa number[6] will be under 11.

The cooking plant (COMPACT COOKING™ process) at the ENCE-CMB pulp mill consists of a chip bin, a pre-impregnation vessel, a high pressure feeder, a continuous digester and a blow tank of 1 000 m^3. The digester is of a compact design and comprises a bottom counter-current washing section. The oxygen delignification takes place in a two-stage oxygen reactor where oxidized white liquor will be used as the alkaline agent. Brown stock washing is carried out with two displacement wash presses and another two displacement wash presses are used for post oxygen washing. The second of the post-oxygen wash presses is located after the high density storage tower, to take advantage of a soaking and leaching process that occur here. Washing efficiency is more than 99% and the open cycle wash losses are about 8kg COD/ADt The final pulp kappa number to the bleach plant is expected to be lower than 10.

2.5.3 Mill Processes: Chemical Recovery

Weak black liquor collected from the brownstock washing system is concentrated by evaporation to produce strong black liquor which is sent to the recovery boiler. In the

[6] Kappa number is used to describe the residual lignin content of pulp. It is a measurement of the residual oxidisable material in pulp. Specifically it is the volume (in mL) of 0.1N potassium permanganate (KMnO4) solution consumed by one gram of moisture-free pulp under the conditions specified in TAPPI Test Method T 236 cm-85.

recovery boiler, organic solids are burned for energy generation and the chemicals are recovered in the form of smelt. Green liquor is formed by dissolving the smelt into weak liquor and is then clarified to remove contaminated solids, known as dregs. The dregs are washed and the resulting weak liquor is used for dissolving the smelt. White liquor is produced in the recausticizing plant. The clarified green liquor is first passed through a slaker where sodium carbonate is converted into sodium hydroxide using lime. The white liquor is clarified to remove precipitated lime mud. Lime mud is converted into lime through calcination in the lime kiln and reused back in the slaker. The lime mud filtered out from the white liquor clarifier is washed before the kiln, and the resulting weak liquor is used for dissolving the smelt from the recovery boiler. The white liquor produced is returned to the digesters as described above.

At the Botnia-Orion pulp mill, a seven-effect evaporator train will be used. In addition to evaporating weak back liquor from brown stock washing, it will treat biosolids from the effluent treatment plant and salt cake from the ClO_2 plant. The evaporation plant was designed with an additional capacity of 20% above normal operation to allow for a sufficient margin to recover intermittent discharges including liquor spills, and for the future possibility of bleach filtrate recycle. The black liquor will be concentrated to a minimum level of 75% dry solids for firing into the recovery boiler. High levels of dry solids help ensure higher lower furnace temperatures and low sulphur dioxide emissions from the recovery boiler. From the evaporators, the clean primary condensates will be returned to the feed water tank of the recovery boiler while secondary condensates will be used in the fiberline and the white liquor plant. The foul condensates, with a higher content of volatile organics, are purified in a steam stripping column to be reused in the process. Non-condensable gases from stripping enter the methanol separation system, where methanol is separated and purified, and the remaining gases enter the collection system for concentrated odorous gases. The stripping column was designed for foul condensate TRS and methanol reduction efficiencies of 98%.

The recovery boiler burns heavy black liquor which is fired into the furnace at high solids. The boiler, which will require fuel oil only for start-up and as occasional support, is a state-of-the-art low odour design with low emissions of TRS, sulphur dioxide and nitrogen oxides. Dust in the flue gas is separated by an electrostatic precipitator. The recovery boiler will be equipped with a burner for low volume high concentration (LVHC) odorous gases. Gases from the smelt dissolving tank will be fed directly into the recovery boiler and all high volume low concentration (HVLC) odorous gases will also be burnt in the recovery boiler. A single lime kiln will be installed. The lime mud will be washed efficiently and dried prior to the kiln, and the lime kiln will be equipped with an electrostatic precipitator to control particulate emissions. The kiln will be fired with fuel oil, and limestone will be used for make-up.

At the ENCE-CMB pulp mill, a 6-effect free flow falling film evaporation train will be used which was also designed to treat biosolids and salt cake from the ClO_2 plant. The evaporation plant capacity is 15% above normal continuous operation which is sufficient for

recovery of intermittent discharges and for recovery of some bleaching filtrates. The weak black liquor will be evaporated to a minimum level of 75% dry solids. The clean primary condensates from the first effect will be collected and returned to the main condensate tank. Secondary condensates will be extracted from the fourth evaporation stage and reused mainly for pulp washing after the oxygen delignification stage. Intermediate secondary condensates will be taken out of the sixth effect and the surface condenser, and introduced into the causticizing plant for lime mud washing and dilution. The foul condensates will be collected from the segregated surface condenser and the vacuum system. They will subsequently be treated in the integrated steam stripper, returned to the intermediate secondary condensate tank, and reused in process.

Gases from the steam stripper are taken to a methanol column where the methanol content is concentrated up to 80%. Concentrated methanol vapour is condensed and stored as liquid in a methanol tank before it is burned in the recovery boiler. LVHC gases collected from the evaporation train and the methanol plant are incinerated in the recovery boiler.

The recovery boiler has been designed for an additional 20% capacity over normal continuous operation of the mill. Concentrated black liquor produced at the evaporation plant is fed to the recovery boiler at a dry solids content of approximately 75%. Biosolids from the effluent treatment plant are included with the black liquor. Oil is used only for boiler start-up and shutdown. The recovery boiler will be equipped with a burner for low volume high concentration (LVHC) odorous gases. Gases from the smelt dissolving tank vent will be fed into the recovery boiler and all high volume low concentration (HVLC) odorous gases will also be burnt in the recovery boiler. Burning vent gases from the smelt dissolving tank decreases the total emissions from the recovery boiler area. In order to control the potassium and chloride content of the mill liquor systems, most of the fly ash collected in the electrostatic precipitators is treated in an ash leaching system in order to remove chlorine and potassium from the process. This leaching system helps ensure that the recovery cycle can accommodate a certain level of alkaline filtrate recycle from the bleach plant. A single lime kiln will be installed. Flue gases leaving the kiln are treated by an ESP and a flue gas scrubber prior to discharge.

2.5.4 Mill Processes: Bleaching

A typical bleaching plant consists of three to five stages which form a bleaching sequence. The bleaching sequence can be divided into two functions: delignification and brightening. In the delignification operation, lignin is removed, while in the brightening operation, higher brightness is achieved.

The 4-stage Botnia-Orion ECF bleaching sequence will be AD-PO-D-P, with DD-washers used in the intermediate washing stages. Botnia-Orion has a low kappa number to the bleach plant, and uses peroxide and oxygen to reinforce bleaching. This result in a comparatively low predicted consumption of chlorine dioxide (less than 10 kg/ADt)

compared with most ECF mills. For this reason, the mill may be described as having an "ECF-light" bleach sequence.

The ENCE-CMB 3-stage ECF bleaching sequence will be D_{Hot} – PO – D. It is expected that once the plant has started up and is in stable operation mode that 20% or more of the alkaline filtrate will be recycled and recovered. ENCE-CMB has a low kappa number to the bleach plant, and uses peroxide and oxygen to reinforce bleaching. This similarly is expected to result in a low consumption of chlorine dioxide (less than 10 kg/ADt) compared with most ECF mills so the bleach plant can be considers "ECF-Light".

The ENCE-CMB and Botnia-Orion bleach plants are using other chemicals to partially replace some of the chlorine dioxide used in ECF bleaching. For ENCE-CMB, this is through use of a hot acidic stage integrated into the first dioxide stage ($D_{Hot,}$) and through a second stage reinforced with oxygen and peroxide. Botnia-Orion achieves this through the use of an acidic stage integrated into the first dioxide stage (AD), a second stage reinforced with oxygen and peroxide (PO), and a final peroxide stage (P). The bleaching sequence development is discussed in greater detail in Annex A of this CIS.

Alkaline bleaching filtrate recycled to post-oxygen washing is recognized as a developing technology by both IPPC-BAT (2001) and Tasmanian-AMT (2004) and is discussed further in Annex A. The planned use of 20 – 25 % alkaline filtrate recycle by ENCE-CMB is a measure beyond BAT for a bleached eucalypt kraft mill.

2.5.5 Mill Processes: Pulp Drying

The bleached pulp is dried and baled before being shipped. The pulp is first dewatered with presses and then further dried with steam in the pulp dryer.

Two drying machines will be used at the Botnia-Orion pulp mill with each a capacity of 60% of the fiberline capacity, which will help with controlling the mill water and steam balance. The ENCE-CMB mill will use a single pulp drying machine with slot screening, double wire, combipress and shoepress design.

2.5.6 Mill Processes: Water Usage and Effluent Treatment

Both the Botnia-Orion and ENCE-CMB effluent treatment plants will employ the activated sludge treatment (AST) process, treating average discharge flows of approximately 73 000 m^3/d (25 m^3/ADt) and 46 000 m^3/d (29 m^3/ADt) respectively.

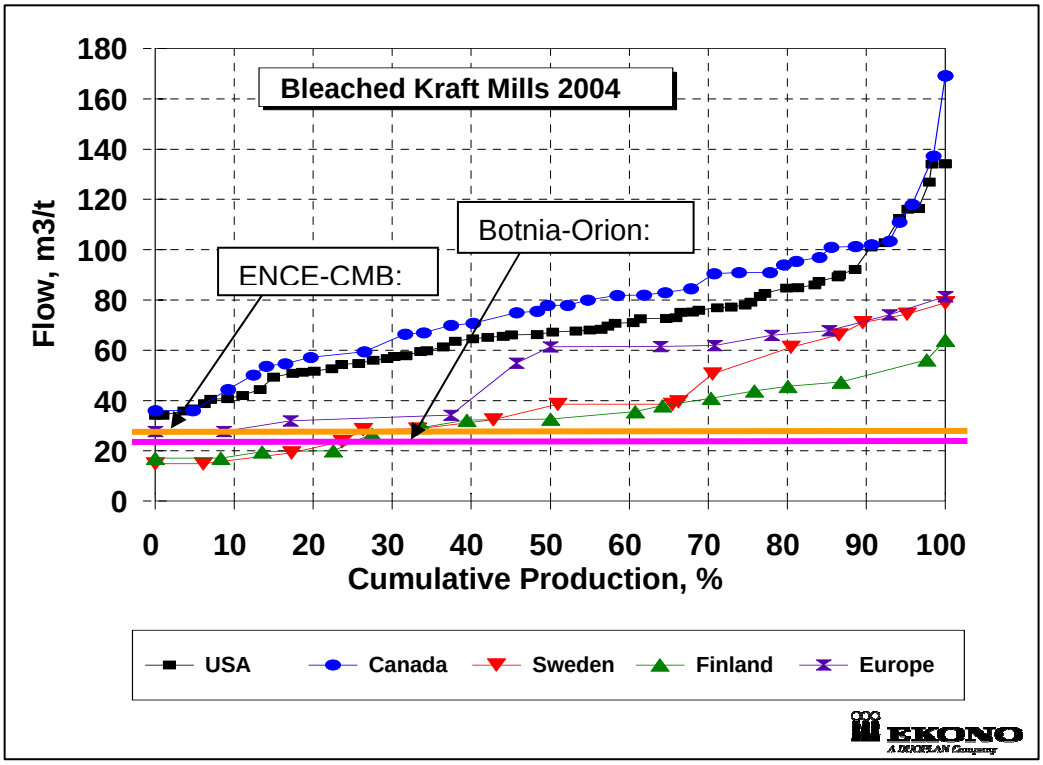
Mill Water Usage and Effluent Flows

In the following figure the effluent flows of Botnia-Orion (in pink) and ENCE-CMB (in orange) are compared with data from North American and European bleached kraft pulp mills. In each of the four countries represented, the medians for effluent flow rates are in the 30 to 80 m^3/ADt range. While a number of mills in North America discharge more than

120 m^3/ADt, all Swedish mills had an effluent flow discharge within the 18–80 m^3/ADt range. The top 10% performing mills discharge under 40 m^3/ADt in North America. It can thus be seen that lower effluent flows than specified by the mill proponents are achievable in some mills, even though both mills would be in the top 5% of performing mills in North America and Europe.

The estimated effluent flows were also compared with modern well operated bleached eucalyptus kraft pulp (BEKP) mills in Brazil. The table below shows that Botnia-Orion's expected average flow matches that of the most modern Brazilian mill effluent flows, namely Veracel's 24 m^3/ADt. ENCE-CMB also performs similarly amongst the best mills in Brazil with an effluent flow of 29 m^3/ADt.

The effluent flows of Botnia-Orion and ENCE-CMB comply with the IPPC-BAT (2001) range and are among the best in the world at the levels estimated for the CIS. Lower effluent flows are achievable but difficult to justify, especially when set in the overall context of concentration-based regulations.



	Botnia Orion	ENCE CMB	Veracel BA, Brazil	Aracruz Barra do Riacho ES, Brazil	Aracruz Guaiba RS, Brazil	Suzano Mucuri BA, Brazil
Flow (m^3/ADt)	25	29	24	35	28	34

Mill Effluent Treatment Processes

An efficient biological effluent treatment system is a critical element of BAT. Secondary or biological wastewater treatment by the activated sludge treatment (AST) process is widely implemented in the pulp and paper industry for the removal of organic matter, and both Botnia-Orion and ENCE-CMB plants will employ a form of the AST process, commonly referred to as “extended aeration” which is considered BAT. A design basis review and analysis of the major equipment to be used by the mill proponents for wastewater treatment was made as part of the CIS. It was found that Botnia-Orion and ENCE-CMB will implement the IPPC-BAT (2001) recommendations for biological treatment. There is no justification for the implementation of tertiary treatment at either of the two proposed mills.

According to the IPPC-BAT (2001) standard, a modern pulp mill must implement biological wastewater treatment in order to be considered BAT. Wastewater treatment must not only comprise biological or secondary treatment, but must also include primary treatment for the removal of solids, neutralization for pH adjustment, effluent cooling, and equalization to minimize the impact of upstream contaminated effluent on the treatment efficiency. Additional recommended technology in IPPC-BAT (2001) and Tasmanian-AMT (2004) includes the addition of a selector, and an anoxic stage for the biological reduction of chlorate. AST systems that implement all of these features can achieve stable and high removal efficiencies for the removal of organic contaminants. Botnia-Orion and ENCE-CMB will both implement the AST process at their facility, namely, they will employ extended aeration AST technology, and include an anoxic zone for chlorate removal and a selector stage. In particular, Botnia-Orion has an innovative design to avoid high organic loads to be charged into the AST. The table below presents the expected removal efficiencies for both WWTP’s and compares them with the recommended IPPC-BAT (2001) levels. Note that the final selection of the WWTP technology had not been made at the time of the CIS, and their predicted removal efficiencies should be considered conservative.

Parameter	IPPC-BAT (2001) recommended removal (%)	Botnia-Orion removal (%)	ENCE-CMB removal (%)
COD	60 – 85	80	70
BOD	85 – 98	98	95
AOX	40 – 65	73	50
Suspended Solids	85 – 90	93	85
ClO_3^-	90 – 100	99	90

Tertiary treatment has been implemented in the pulp and paper industry at a few mills, particularly for additional nutrient and color removal from the effluent. On the other hand, a number of studies and reports regarding the performance of tertiary treatment systems indicate that, for various reasons, tertiary treatment should not be considered BAT. It can for example, increase the chemical load on the environment and add cost and complexity to the treatment system. Since both Botnia-Orion and ENCE-CMB will implement the state-of-the-art effluent treatment plants, and impact from any additional reduction in color and nutrients is likely to be marginal and insignificant, tertiary treatment is not considered to be necessary or environmentally desirable in either mill case.

2.5.7 Summary Statement Regarding BAT Analysis for the Botnia-Orion Pulp Mill

The detailed BAT analysis for the Botnia-Orion mill is presented in Annex A. The mill will incorporate state-of-the-art technology which is BAT, and in some cases goes beyond IPPC-BAT (2001) and Tasmanian-AMT (2004) definitions of BAT.

2.5.8 Summary Statement Regarding BAT Analysis for the ENCE-CMB Pulp Mill

The detailed BAT analysis for the ENCE-CMB mill is presented in Annex A. The mill will incorporate state-of-the-art technology which is BAT, and in some cases goes beyond IPPC-BAT (2001) and Tasmanian-AMT (2004) definitions of BAT.

2.6 Bleaching Processes

For a bleached eucalyptus kraft pulp (BEKP) mill, liquid effluent from the bleaching area typically contributes about half of the flow, and most of the organic load. Selection of the chemical stages, and conditions to be used in them, comprise critical environmental design decisions. Design considerations regarding these issues include wood type, required final product characteristics and special knowledge developed by the owner, and available equipment. In reviewing the bleaching processes we have used knowledge of recent BEKP

mills (in Brazil, South Africa, and Chile), other new or rebuilt bleached kraft mills (in Germany, China, and Finland), and knowledge developed by ENCE and Botnia (for example in mill and laboratory trials, and operating mill experience). Members of the CIS project team have visited many of these mills within the last year, and have also used the IPPC-BAT (2001), Tasmanian-AMT (2004) and the USEPA Cluster Rule in reviewing the mills. This section discusses the key areas associated with bleach plant technology selection and emissions from bleaching including oxygen delignification, dioxin and furan generation, bleaching, ECF, TCF and ECF-Light bleaching and recycling of alkaline filtrates to post oxygen washing.

Oxygen Delignification: Oxygen delignification reduces the lignin content of pulp prior to bleaching, through the use of oxygen gas and sodium hydroxide. Organic material is dissolved and recycled back from the post oxygen washers to the brown stock area and then to the chemical recovery system. Modern two-stage delignification is proposed by both the Botnia-Orion and ENCE-CMB mills.

Dioxins and Furans Generation in Bleaching; From the 1950's through to the 1980's bleached pulp manufacture employed primarily chlorine (Cl_2) as the main delignification chemical after cooking, followed by caustic, sodium hypochlorite and possibly chlorine dioxide stages. Bleaching sequences from this period were typically CEH, CEHD and CEHDED. The use of chlorine for delignification in sequences such as these has been found to produce dioxins and furans. Preventing the formation of 2,3,7,8-TCDD and 2,3,7,8-TCDF in bleaching is achieved mainly by decreasing the amount of chlorine used in the first bleaching stage. The bleaching processes used at Botnia-Orion and ENCE-CMB use no elemental chlorine in bleaching, and will not produce dioxin and furans at significant levels.

ECF and TCF Bleaching: Two approaches have been taken by pulp manufacturers in response to concerns on dioxin emissions in mills using chlorine bleaching in the 1980s. One approach was to eliminate molecular or elemental chlorine-based chemicals, referred to as ECF bleaching [i.e. bleaching sequences in which molecular chlorine (Cl) and hypochlorite are not used]. The second approach was to bleach with no chlorine-based chemicals, which is called TCF bleaching (i.e. bleaching that uses only oxygen-based chemicals such as oxygen, ozone, alkaline or acidic peroxide). Botnia and ENCE were leaders in the adoption of TCF technologies, and today 21% of Botnia's and 38% of ENCE's production is manufactured using the TCF process. In selecting a bleaching technology for Uruguay, both companies investigated a range of ECF, TCF and ECF-Light technologies (an "ECF-Light" technology essentially has attributes of both ECF and TCF production). The ECF-Light technologies were selected as pulp from the TCF sequences has lower yields and poorer final quality than the ECF and ECF-Light pulps.

ENCE has found that pulp using the same TCF method that they use in the Pontevedra mill in Northern Spain could not reach the necessary market brightness, and that the final brightness reduces during transportation of product (a phenomenon called reversion). If

ozone was used in the sequence, full brightness can be made but the pulp has much reduced papermaking properties, especially strength, that renders it unacceptable for market. Botnia has found that TCF bleaching produces inferior fibre quality, namely fibre strength. Cooking yield is lower for TCF sequences, as they require a lower Kappa to bleach plant, and this results in higher wood consumption.

The ECF versus TCF question was recently examined by the Government Agency (RPDC) responsible for permitting new pulp mills in Tasmanian, Australia. The RPDC review was carried out in May 2006, and the report has more than 140 references, covering experiences in North America, Europe and South America[7]. The report concluded that TCF pulp and ECF pulp have similar environmental impacts from air and water emissions, and neither emit dioxins at environmentally significant levels. The report also concluded that TCF pulps generally have poorer strength at equivalent brightness, and lower yields than comparative ECF pulps. Neither technology offers significant advantages in terms of operating risk, safety and occupational health considerations. Both technologies are acceptable under the Stockholm Convention of POPs, IPPC-BAT, USEPA and all significant permitting authorities.

ECF and ECF-Light Bleaching: A conventional cooked hardwood pulp, without oxygen delignification may use 35 kg/ADt of chlorine dioxide. The sequences proposed by the Botnia-Orion and ENCE-CMB mills are expected to use about 8 kg/ADt and less than 10 kg/ADt of chlorine dioxide, respectively. These bleach sequences are termed “ECF-Light”. The expected color, COD and AOX discharges from the bleach plants are subsequently expected to be extremely low compared to conventionally bleached pulp mills.

Recycling alkaline bleaching filtrate from the bleach plant; Both Botnia-Orion and ENCE-CMB are taking a cautious approach with respect to recycling alkaline bleaching filtrates to the recovery cycle. Both mills will recycle filtrates within the bleach plant. This practice reduces water consumption, effluent flow and reuses chemical residues within the bleach plant. Botnia-Orion and ENCE-CMB have installed equipment and connections to enable alkaline bleaching filtrate back to post-oxygen washing. This recovers bleaching chemicals used and may reduce effluent flow. ENCE-CMB plan to recycle about 20-25% of the alkaline filtrate under standard operation. Botnia-Orion will test alkaline filtrate recycle after the new mill operation is started-up and stabilized, likely within two years of start-up. Alkaline bleaching filtrate recycle was identified as an emerging technology by IPPC-BAT (2001) and Tasmanian AMT (2004).

EcoMetrix has not identified any BEKP mills which recycle alkaline bleaching filtrates to brown stock. This is not practiced for example in the most recent installations in Veracel and Aracruz C Line in Brazil, which also were built with the IPPC-BAT (2001) as a

[7] www.rpdc.tas.gov.au/projects_state_signif/pulp_mill/pm_reports_publications.html.

guideline. Alkaline filtrate recycle is not as effective with eucalyptus furnish as compared with softwoods, and potential problems are more severe than with softwoods due to the following reasons:

1. Eucalyptus has a higher Hexenuronic acid content than other woods, and this results in higher levels of oxalate formation (the oxidation product of Hexenuronic acid), and higher oxalate levels in alkaline filtrates. Oxalate causes both bleach plant and evaporator scaling (forming calcium oxalates).

2. In softwood mills the alkaline bleaching stage generally has a high load of organics (color and COD) compared with the first bleaching stage (the D stage). The modern BEKP mill bleaching sequences often contain two separate functions in the first bleaching stage. These are a specific Hexenuronic acid removal stage, and a regular oxidation stage (for example A/D D_{HOT} or Z/D). This results in the first stage effluent having more organic content (color, COD) and the second stage (the alkaline extraction stage) less organic content (color, COD) than for other wood furnishes. The effluent load reduction potential from recycling alkaline filtrate is thus comparatively less.

3. Eucalyptus mills have higher potassium inputs than softwood and northern hardwood mills. This results in a lower tolerance for chloride inputs from bleaching filtrates, before recovery boiler operation problems are encountered, or increases the requirement to purge chlorides and potassium from the liquor cycle. ENCE-CMB has a precipitator dust leaching stage to reduce liquor cycle potassium and chloride levels.

Summary

ENCE and Botnia have combined their operating experience and process knowledge with vendor offers to develop fiberline (and complete mill) configurations that would be welcomed in Canada, the USA or Europe. The companies in almost all respects have put together the best process technologies, and are likely to perform better than any of their existing mills with respect to environmental performance. The selection of two-stage oxygen delignification, ECF-Light bleaching and the cautious approach to alkaline filtrate recycling taken by both mills is consistent with BAT for BEKP mills, and the mills will implement state-of-the-art Hexenuronic acid removal stages. The expected performance with respect to bleaching effluent flow, COD content and color will be among the best in the world.

2.7 Evaluation of Emissions and Effluents

Kraft pulping process effluents contain oxygen-consuming organic substances that are measured as Chemical Oxygen Demand (COD) and 5-day Biological Oxygen Demand (BOD_5). Effluent from the bleach plant, where chlorine-containing bleaching chemicals are used, contains organically-bound chlorine compounds, measured as Absorbable Organic

Halides (AOX). AOX is a measure of a wide range of chlorinated organic compounds, many of which are found naturally in the environment. The AOX measurement may also include polychlorinated, persistent compounds. Emissions of coloured substances may affect aquatic ecosystems through decreased transparency of water. Emissions of nutrients (nitrogen and phosphorus) can result in eutrophication of water bodies. Individual metals extracted from the wood can also be detected in low concentrations in effluents.

The treated effluent from kraft pulp mills contains principally dissolved inorganic solids or salts of sodium and calcium (i.e. sodium chloride, calcium bicarbonate, and sodium and calcium sulphates), and low concentrations of residual organics measured as BOD_5 and AOX. Discharge of inorganic salts is typically regulated only in locations with low rainfall, and low stream flows which may be used for agricultural irrigation, such as in South Africa, Australia and Thailand.

Kraft pulp mill emissions to the atmosphere may originate from chip storage, the cooking process, pulp washing, the bleach plant, bleaching chemical preparation, chemicals recovery, evaporation, biomass boiler, recovery boiler, white liquor preparation, lime kiln, tanks and pulp drying. They consist mainly of products of combustion, including particulate matter, NO_x and SO_2, as well as malodorous reduced sulphur compounds, commonly referred to as Total Reduced Sulphur (TRS) compounds. Nitrogen oxides are emitted from furnaces as well as small amounts of dust (solid particulates) as fly ash. From the bleach plants and preparation of bleaching chemicals, chlorine compounds may escape to the atmosphere.

Because of rapid developments in pulping technology, environmental protection equipment and mill operating practices through the 1990's, literature published before about 1995 on pulp industry discharges and their environmental impacts must be interpreted with caution, as the characteristics of the industry discharges have changed significantly since that time[8]. The environmental issues that remain differ significantly from those of the past. Modern kraft pulp mills such as those being evaluated in this CIS, have discharges which are significantly less than those of older smaller mills, due to the implementation of state-of-the-art process technology suitable for large throughputs. Discharges are lower not only in specific terms, on a per ton of production basis, but also in absolute terms (in a ton per day basis), compared with older mills. Implementation of state-of-the-art technology alone is not enough to guarantee "best available technology" or BAT; it is critical that the equipment is well-operated and maintained so that operating objectives are consistently met over the longer term. Both the process technology and its future operation have been addressed in this BAT assessment.

Key emission issues for state-of-the-art kraft pulp mills are related to the collection and management of TRS-containing odorous gases, and effluent color. TRS collection and

[8] Northcote, T. G. and G. E. Hartman. 2004 Fishes and Forestry Worldwide Watershed Interactions and management, Blackwell Science, Oxford ISBN 0-632-05809-9 page 246

management is being addressed to a great extent by the implementation of state-of-the-art non-condensable gas (NCG) collection systems at both mills that go beyond IPPC-BAT (2001), and effluent color reduction is being addressed by selection of modern pulping and bleaching technologies and an extensive spills collection systems that are systematically designed using principles similar to those defined in the Best Management Practices (BMP) requirement of the USEPA Cluster Rule (2000).

Botnia-Orion and ENCE-CMB were asked to provide long term annual average, monthly maximum and daily maximum estimates for parameters listed in the IPPC-BAT (2001) guidelines as well as for a number of additional parameters that will either be regulated by DINAMA or are of general concern. The IPPC-BAT (2001) standard establishes achievable emission levels for a certain number of key parameters for bleached kraft pulp mills. For this BAT analysis, the range of discharges rates was compared with the estimates provided by the mill proponents as shown in Table 2.7-1. The summary of mill emissions in the table is for the total emissions to each of the air and water receiving environments. Fugitive emissions, in particular those from the wastewater treatment plant (including primary clarifier), will be very low for both the Botnia-Orion and ENCE-CMB because of the low sulphidity level of the eucalyptus pulping process and because of the extensive spills collection system to be implemented at both mills.

Table 2.7-1: Comparison of Emission Rates (annual average)

	IPPC-BAT (2001) Guidelines	World Bank Group Emission Guidelines	Botnia-Orion Long term average	ENCE-CMB Long term average
Effluent				
Flow (m^3/ADt)	30 – 50	-	25	29
BOD_5 (kg/ADt)	0,3 – 1,5	-	0,3	0,6
COD (kg/ADt)	8 – 23	15	8,0	8,7
AOX (kg/ADt)	< 0,25	0,20	0,08	0,10
Suspended solids (TSS, kg/ADt)	0,6 – 1,5	-	0,7	0,9
Total nitrogen (kg/ADt)	0,1 – 0,25	0,4	0,15	0,17
Total phosphorus (kg/ADt)	0,01 – 0,03	0,05	0,012	0,017
Air emissions				
Particulate matter (kg/ADt)	0,2 – 0,5	-[9]	0,30	0,34
Total S (kg/ADt)	0,3 – 0,6	1,0	0,35	0,26
SO_2 (as S) (kg/ADt)	0,2 – 0,4	-	0,30	0,23
NO_x (as NO_2) (kg/ADt)	1,0 – 1,5	2,0	1,35	1,30
TRS (as S) (kg/ADt)	0,1 – 0,2	-	0,05	0,03
CO (kg/ADt)	-	-	1,7	1,7

The mill proponents' water and air discharge estimates were then compared with the average discharges from some of the best bleached eucalyptus kraft pulp (BEKP) mills in South America. It was found that the proposed emission rates for the new pulp mills were, for the most part, equivalent to the Uruguay mills. A comparison of the Botnia-Orion and ENCE-CMB mills with the best company mills in Finland and Spain, showed that the design experience of each company has been incorporated into the design process of the Orion and CMB BEKP.

[9] The World Bank Group has a guideline for particulate matter in the recovery boiler of 100 mg/Nm^3. Where achieving 100 mg/Nm^3 is not cost-effective, an emissions level up to 150 mg/Nm3 is acceptable. Air emissions requirements are for dry gas, at 0°C and 1 atmosphere. Based on performance guarantees, the Botnia-Orion and ENCE-CMB mills should discharge particulate matter of 42 mg/Nm^3 or less.

The permit-setting process used by DINAMA was evaluated and found to be practical and rigorous and, through DINAMA's receiving environment monitoring program and permit renewal process, it will be ensured that the proposed pulp mills will have a minimum impact on the receiving environment. When benchmarked against other jurisdictions, DINAMA's standards were found to be amongst the world's most stringent.

Based on this comparative review and the experience of the CIS project team, the emission rate estimates provided by Bontia-Orion and ENCE-CMB are reasonable, and are consistent with BAT. Both mills have been designed to perform at or better in almost all cases, than the IPPC-BAT (2001) and Tasmanian-AMT (2004) standards, and will perform at world-class levels with regards to water and air emission rates.

Summary

The most widely accepted definition of BAT, and the basic standard that has been used for the design of the Botnia-Orion and ENCE-CMB pulp mills is that of the European Union, IPPC-BAT (2001). This is the design standard for new mills in the European Union, however has also been used by many other leading mills around the world, including the following:

- the Veracel mill in Brazil was designed to IPPC-BAT (2001);
- Arauco in Chile is in the process of retrofitting their Valdivia mill to the IPPC-BAT (2001) standard (particularly for their odorous gas systems); and
- Aracruz and Suzano in Brazil benchmark their mill environmental performance against the IPPC BAT (2001) standard.

In order to assess BAT for the Botnia-Orion and ENCE-CMB mills, a methodology was systematically executed for the purposes of this CIS. The methodology and results can be summarized as follows:

1. ***Assessment of the mill's compliance with the emission levels achievable with the use of BAT****:* Based on emission levels from the IPPC-BAT (2001) and Tasmanian-AMT (2004) standards, it was found that the mills are implementing BAT. Furthermore, a comparison was made between the proposed mill emission rates and other mills including state-of-the-art BEKP mills in Brazil, as well as other well-operated Botnia and ENCE mills. It was found that the proposed emission rates for the new pulp mills were generally at an equivalent or better performance level than these mills.
2. ***Assessment of whether the environmental regulating body in Uruguay, DINAMA, has a comprehensive plan to ensure the BAT standard will be met through their permitting process and requirements****:* DINAMA is employing a staged process to issue management plans for each of the two pulp mills as engineering and construction activities progress, which is expected to lead to the AAO or operating permit for the mills. Both concentration-based and

loading-based discharge requirements are expected for the effluent, in addition to well-defined atmospheric emission limits. The mill proponents and DINAMA are currently discussing monitoring and reporting requirements, which will be used as the basis for the operating permit renewal required every 3 years.

3. ***Assessment of whether BAT has been included in the mill equipment design****:* IPPC-BAT (2001), Tasmanian-AMT and certain USEPA Cluster Rule (2000) requirements have been summarized, and targeted issues have been discussed in greater detail in sections of Annex A. Both mills will employ state-of-the-art process technology.
4. ***Assessment of BAT operating requirements****:* The Botnia-Orion and ENCE-CMB mills were evaluated regarding their plans for solid waste management practices, monitoring plans including those implemented in other operating mills, training and motivation of mill personnel, process control, equipment maintenance, environmental management systems (EMS), and plans for communication with the community. Based on a review of progress achieved to date and future plans, both mills will seek to employ state-of-the-art practices in regards to these issues.

In summary, based on the above analysis, the BEKP mills proposed by Botnia-Orion and ENCE-CMB are considered by EcoMetrix to be IPPC-BAT (2001) or better.

2.8 Schedules and Timelines

Figure 2.8-1 provides a timeline of present plans (current at the time of writing) for construction, first operations and full production for the two plants.

The worker numbers and traffic volume over time have been estimated for four project scenarios: the “no projects” scenario; Botnia only; ENCE only; and both Botnia and ENCE together. The employment and traffic trends are shown in Figures 2.8-2 and 2.8-3, respectively.

Figure 2.8-1: Projected Timeline for the Two Plants (Construction to Full Production)

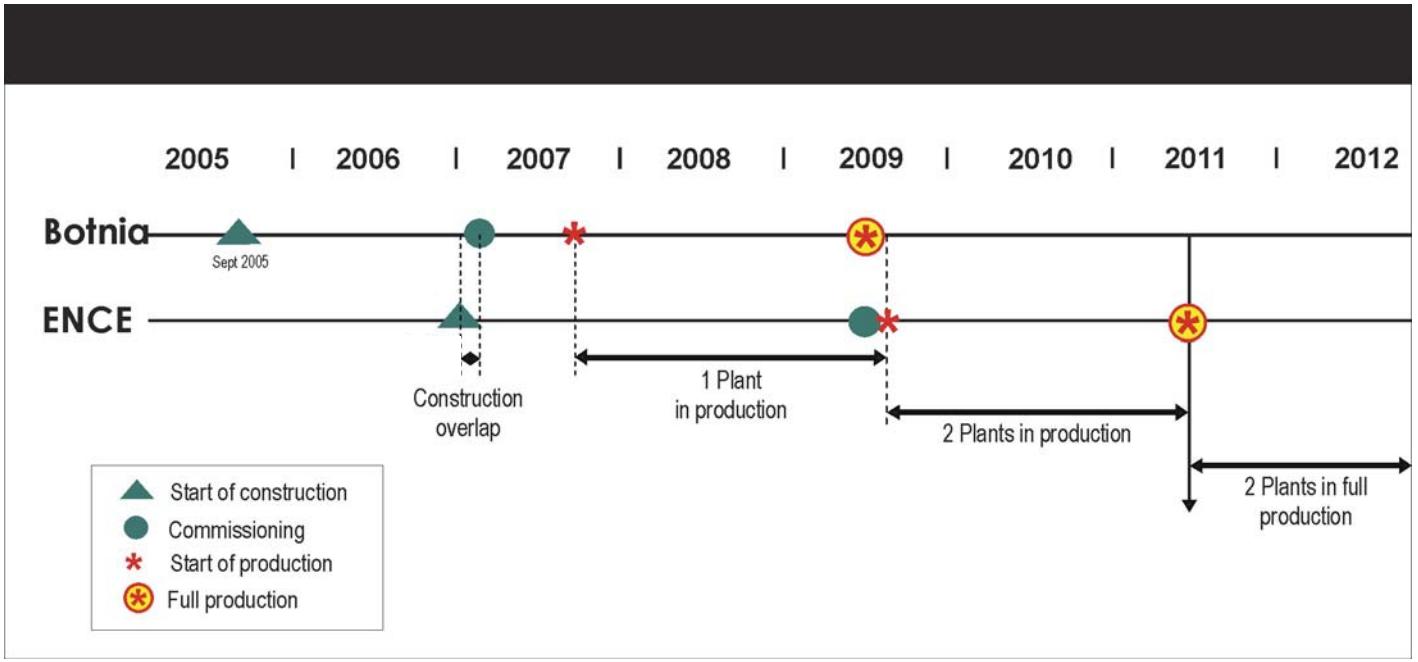


Figure 2.8-2: Projected Number of Workers

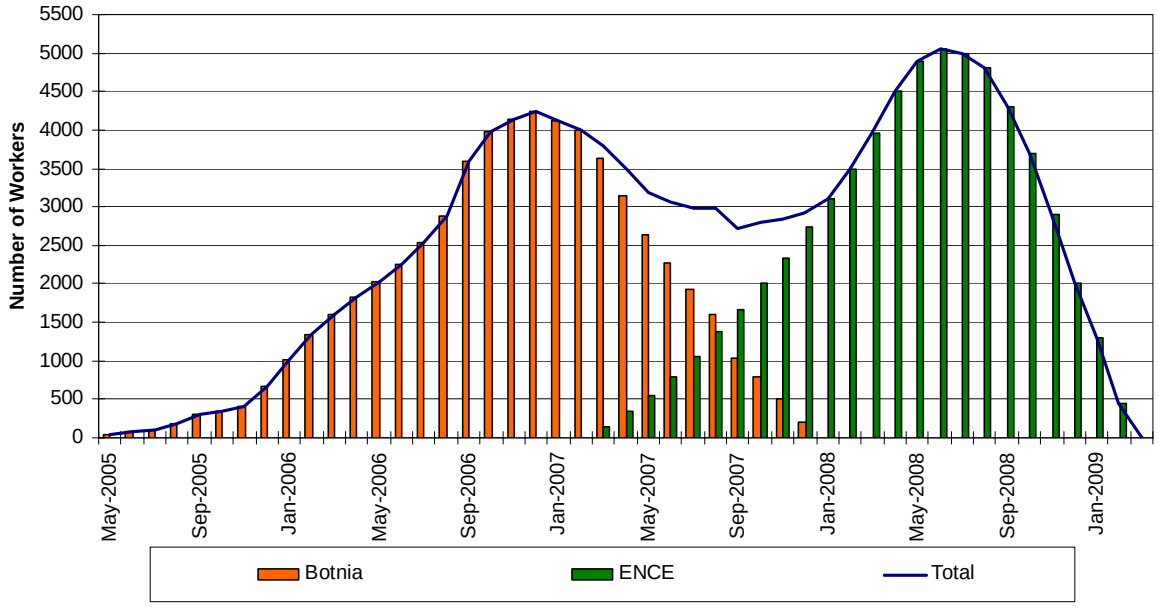
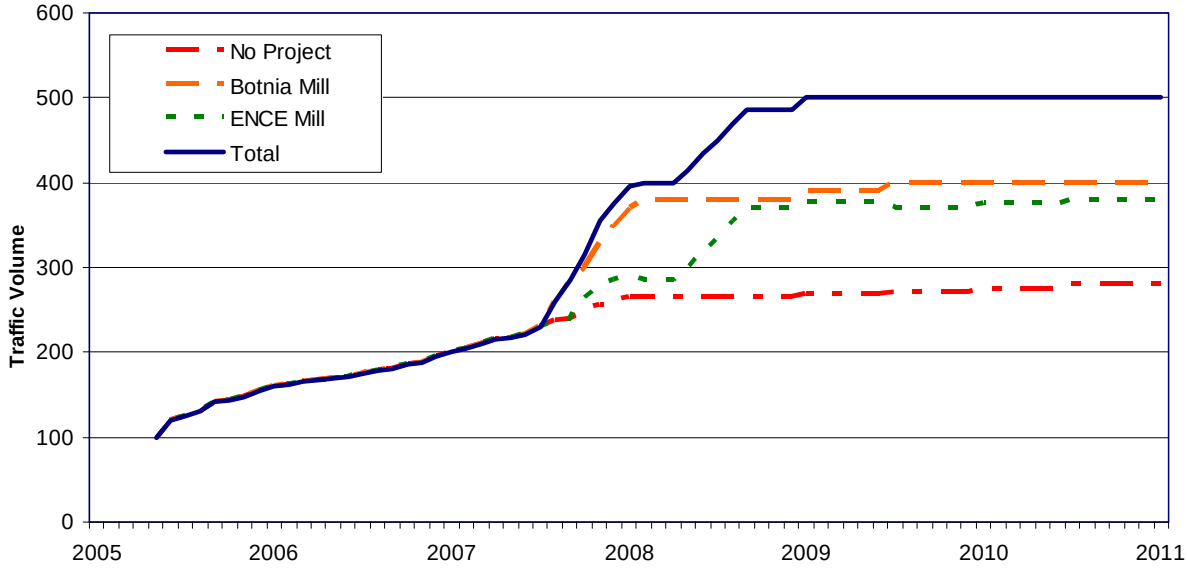


Figure 2.8-3: Projected Traffic Volume



3.0 ENVIRONMENTAL AND SOCIAL SETTING

The baseline environmental and social setting for the projects is presented in the following sections. This information provides the context from which the potential cumulative effects of the projects are assessed. It includes an overview of land features, air environment, aquatic environment, and social setting. Additional details are provided in Annexes C, D and E, relating to air quality assessment, water quality assessment and socio-economic assessment, respectively.

3.1 Overview of the Land Features

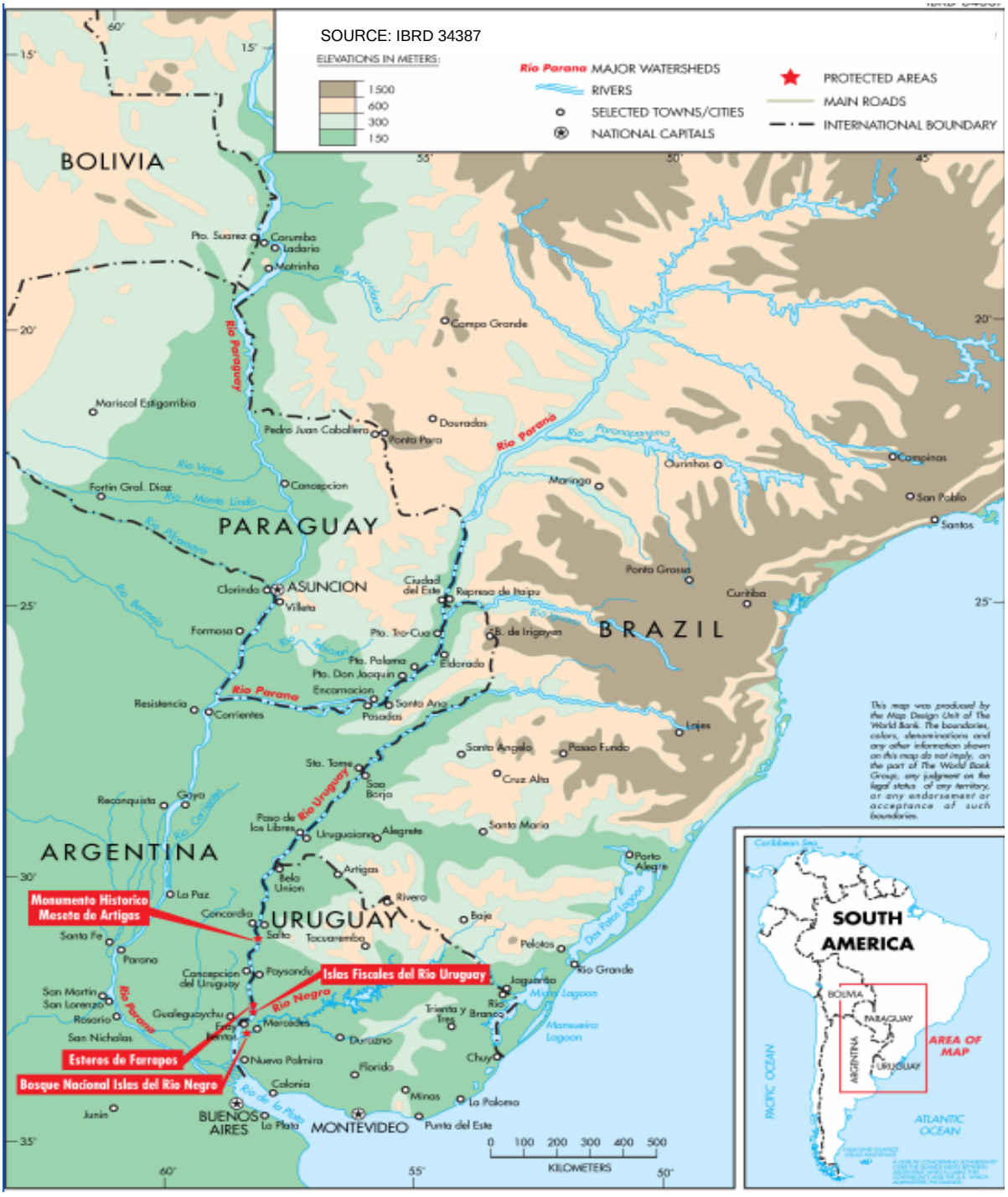
The western Uruguay region where the pulp mill sites and many of the eucalyptus plantation operations are located is characterized by gently rolling terrain primarily in agricultural use. About 50% of farms tend to be very large, and agricultural production is a mix of cattle grazing land, corn and soy production, and forest plantations. There are areas of natural tree growth in the landscape, usually in floodplains or low-lying areas (gallery forest). These natural areas are mostly open-canopy, low-growing, deciduous forests that have been modified by grazing activity over the centuries since initial colonization.

There are no designated protected natural areas in the immediate vicinity of the pulp mill sites. The nearest are Potrero del Burro (or, Rincón de las Gallinas) about 14 km southwest of Fray Bentos, and Bosque Nacional Islas del Río Negro located south of Fray Bentos. Other designated protected areas include Esteros de Farrapos (a designated Ramsar site) and Islas Fiscales del Río Uruguay, located further upstream of the project sites (see Figure 3.1-1).

Nearly 38% of the total land area of Paysandú, Río Negro and Soriano is dedicated to agriculture and 70% of all agricultural operations in the three departments involve dairy, beef cattle and sheep ranching. Approximately half of all agricultural operations in each of the departments – 2,400 in Paysandú; 1,361 in Río Negro and 2,197 in Soriano – constitute 100 ha or less. From 1985 to 2000, the three departments together experienced a 14-fold increase in the amount of land area devoted to plantation forestry in response to government legislation promoting forestry. At present, forest plantations accounts for 6.8% of cultivated land in Paysandú, 7.4% in Río Negro and 2.5% in Soriano. In Gualeguaychú department, approximately 30% of the total land area is dedicated to agriculture of which crop farming represents 19% of land use and, cattle pasture represents 52%.

The primary road network in the Fray Bentos and Paysandú area is paved with widening and improvements still occurring. These activities have been funded in part by the World Bank through its Forest Transport Sector project loan to the Government of Uruguay. Many of the secondary roads are paved, and tertiary roads have gravel surfaces, but these are generally in good condition and well maintained. In this region (and throughout Uruguay) the north-south road network is well developed and maintained, whereas the road network is not well developed in the east-west direction.

Figure 3.1-1: Major Watersheds and Natural Features



Large and small beach areas along the Río Uruguay are used for recreational purposes. The closest established recreational area to the project sites is Playa Ubici, on the east side of Fray Bentos and within view from the Botnia project site. There are other recreational sites within and south of Fray Bentos; all are out of view of the Botnia Plant. Balneario Ñandubaysal is located to the west-northwest on the Argentina side of the river about 13 km from the Botnia project area (see Figure 1.1-1). Given its distance, the presence of the low-lying islands along the Argentina shoreline, and the difference in elevation between the Botnia site and the beach, some components of the Botnia project, especially the chimney, are visible in the distance from the Ñandubaysal beach, as is the international bridge and chimney of the now defunct meat processing plant in Fray Bentos.

3.2 Overview of the Aquatic Environment

The Río Uruguay is the aquatic environment of primary interest with respect to potential mill impacts, since this river will receive the treated effluents from both mills. The existing condition of the aquatic environment of the river is described in detail in Annex D, Section 3. It is summarized here, with respect to river setting and hydrology, water and sediment quality, and fish and invertebrate communities.

3.2.1 River Setting and Hydrology

The Río Uruguay is, after the Río Paraná, the most important river draining to the Río de la Plata. The watershed for the Río Uruguay covers a surface area of approximately 365,000 km^2, of which 51% is in Brazil, 33.5% is in Argentina and 15.5 % is in Uruguay. Figure 3.1-1 presents a map of the basin for the Río Uruguay which shows the locations of the project sites.

The morphology of the river changes along its approximately 1,800 km length. The upper and middle reaches above the Salto Grande Dam, are characterized as riverine environments with relatively narrow channel width, steep channel slope and various rapids. In contrast, the lower reaches are characterized as estuarine environments with a relatively wide and flat channel with numerous islands. It is within the lower reach where the two projects are located.

Through the lower reaches, the channel continues to change as the river travels across the lowlands of Uruguay and Argentina. The width of the river is the most obvious indicator of this change. Near the Salto Grande Dam, the river is generally less than 0.5 km wide. The river continues to widen to 1.8 km near Fray Bentos, to 6.0 km near Las Cañas, to a maximum of 20 km near Nueva Palmira.

As the river widens, its capacity to carry sediment gradually diminishes. This is most evident by the formation of the Río Uruguay Island Delta located below Paysandú. By Fray Bentos, most of the coarse sediment load is depleted, although the river still carries a considerable load of fine suspended sediment as evident by the high turbidity of the water.

Some of this fine sediment may settle in shallow embayments and sheltered areas such as Yaguareté Bay.

The average flow in the Río Uruguay at the Salto Grande dam is approximately 6,230 m^3/s, based on historic records over the period 1983 to 2003. However, flows can vary substantially based on season, precipitation and operation of the dam. As an example, the monthly average flow varied from a minimum of 500 m^3/s to a maximum of 22,500 m^3/s over the 20-year period of record.

The flow at Fray Bentos is expected to be somewhat higher than the flow at Salto Grande Dam due to the increased drainage area between the two locations. Prorating flow on a drainage area basis yields an estimate of the drought flow for the Río Uruguay at Fray Bentos. The annual, 5-year and 20-year drought flows are estimated to be 950, 640 and 400 m^3/s, respectively.

The flow in the river can be influenced by wind effects when the flow at the Salto Grande dam is very low. Regional winds over the Atlantic Ocean and local winds over the Río de la Plata cause wind seiche (which is a rise and fall of the water elevation in response to the wind). This wind seiche in turn can cause the flow within the Río Uruguay to temporarily increase or decrease in response. On rare occasions, the flow can reverse direction and travel upstream for short periods of time. These flow reversals may occur a few times per year or less frequently, and only occur during low flow conditions at the Salto Grande Dam (1,000 m^3/s or less) and during extreme winds that cause a rapid rise in water elevation (1 m or more within a few hours) (pers. comm. Piedra-Cueva, 2006).

3.2.2 Existing Water Quality

In general, the quality of water in the Río Uruguay is considered good but there are localized issues and exceedances of water quality criteria. In 1992, Estudio Nacional Ambiental (OPP-OEA-BID) concluded that the Río Uruguay is in good general condition, but noted water quality problems in some areas, including Bella Union, Salto, Concordia, Paysandú and the mouth of the Río Gualeguaychú. This localized deterioration of water quality was primarily attributed to runoff from areas of intense agricultural use and discharges from urban centers and industries with inadequate effluent treatment.

The quality of water in the Río Uruguay has been extensively studied by CARU from 1987 to date (e.g., CARU, 1993, 2005a). In addition, baseline water quality sampling has been conducted by the mills in association with each of the two projects. Water quality sampling has also been conducted for the CMB port facility.

Based on a review of the data contained in these documents, monitoring data for the vast majority of constituents shows compliance with applicable water quality standards, with the possible exception of fecal coliforms, dissolved oxygen, ammonia, phosphorus, chromium, iron and zinc. These exceedances can pose a risk to human health and aquatic life, affect

the aesthetic quality of recreational waters, and increase growth of aquatic plants in shallow embayments.

Water quality data for the 1997-2004 period in the vicinity of the two mill projects were summarized by CARU (2005a) and updated by GTAN (2006). Of particular interest, phenolics were found to frequently exceed the water quality criterion of 1 μg/L, with the highest values on the Argentina side of the river.

Some chemical parameters considered relevant to mill operations do not have water quality criteria, and have not been routinely measured in the Río Uruguay. These parameters include adsorbable organic halides (AOX), chlorophenolics, resin and fatty acids, dioxins and furans, and phytosterols. Special studies commissioned by Botnia (Tana, 2005, 2006) have documented baseline levels of these constituents in the river.

Table 3.2-1 presents a summary of water quality data for the Río Uruguay in the vicinity of the mill projects for parameters of particular interest to mill operations, based on a synthesis of data from the various sources.

Table 3.2-1: Summary of Water Quality Data for Key Parameters on the Rio Uruguay in the Vicinity of Fray Bentos

Parameter		
Total suspended solids (TSS)	Average 16 mg/L (2-58 mg/L) 4-41 mg/L	CARU (1993) Algoritmos (2006)
Biological oxygen demand (BOD)	Average 4 mg/L (1-10 mg/L) 3-5 mg/L 0.1-1.8 mg/L	CARU (1993) GTAN (2006) Algoritmos (2006)
Chemical oxygen demand (COD)	1-2 mg/L 20 mg/L <5-15 mg/L	Botnia (2004) GTAN (2006) Algoritmos (2006)
Total nitrogen (N)	Average 0.45 mg/L (0.19-0.93 mg/L) 0.35-1.10 mg/L	CARU (1993) Algoritmos (2006)
Total phosphorus (P)	Average 0.1 mg/L (0.04-0.24 mg/L) 0.13-0.22 mg/L	CARU (1993) Algoritmos (2006)
Nitrate (NO_3)	1-2 mg/L 0.2-5.9 mg/L 0.36-0.79 mg/L	Botnia (2004) Botnia (2005/06) Algoritmos (2006)
Adsorbable organic halides (AOX)	2-8 μg/L <2-12 μg/L <1-6.8 μg/L	Botnia (2004) Botnia (2005/06) Algoritmos (2006)
Chlorophenols	0.08-0.11 μg/L 1-12 μg/L	Tana (2005, 2006) Algoritmos (2006)
Phytosterols	ND[1] – 22 μg/L	Tana (2005, 2006)
Dioxins and Furans	ND[2] – 50 pg/L	Tana (2005, 2006)

[1] ND = <1 to <3 μg/L.
[2] ND = <0.2 to <2 pg/L.

3.2.3 Existing Sediment Quality

The sediments of the Río Uruguay were studied in the nearshore zone near Nuevo Berlin, Fray Bentos and Las Cañas (CELA, 2005, 2006) and specifically in Yaguareté Bay (CELA, 2005a,b), as part of Botnia's baseline characterization of the river. At most locations, the substrate type was predominantly sand, containing organic matter in the 1 to 6% range. Nitrogen and phosphorus were measured as indicators of nutrient enrichment. Both tended to be somewhat higher in the fall (April) as compared to summer months. In Yaguareté Bay in November/December, total phosphorus was 12 to 26 μg/g fresh weight (FW) of sediment, and nitrogen was 33 to 88 μg/g FW. Higher values of N in April were 38 and 416 μg/g FW, respectively.

Metal and organic contaminant data for Río Uruguay sediments have been collected over the years by CARU at various locations of interest. They indicate generally good sediment quality, with some locally high concentrations of chromium and copper, particularly downstream of urban centres.

3.2.4 Fish Community

The lower Río Uruguay supports more than 100 fish species. Generally, 17 species are captured regularly by the artisan fishermen of the area. The Uruguayan catch totals approximately 1,600 tons each year (DINAMA, 2003; CARU, 2005b). Based on recent catch statistics, the most important species are sabalo, boga, mullet, tarira, dorado and various catfishes (pati, armed, yellow). Sport fishing is also important. Favoured sportfish species include the golden dorado and some catfishes.

The fish community includes both mainstem and tributary species. The mainstem species reproduce and complete their life history in the main river channel, while tributary species migrate into tributaries, like the Río Paraná, to spawn and produce larvae. The sabalo and boga are both migratory, using the Río Paraná for spawning. Another migratory movement for the sabalo seems to be upriver towards the Salto Grande Dam. Spawning occurs both above and below the dam. The golden dorado is known to spawn directly below the dam, primarily in October to December.

Non-migratory fish species, such as carp and some catfishes, will spawn throughout the Río Uruguay, particularly in shallow embayments. Therefore, embayments in the vicinity of the mill projects, such as Yaguareté Bay, will likely be used for this purpose. They will also be used as nursery or feeding areas for the fry and juveniles of many species, including some migratory species. However, no major migratory fish species or species important to the fishery are known to spawn in the vicinity of the proposed mills.

3.2.5 Aquatic Invertebrates

The benthic invertebrate community in the lower Río Uruguay was characterized by CELA (2005, 2006). In most samples collected, dominant taxa were either tubificid worms, midge larvae or invasive mussels (golden mussel). Snails and clams were also common and were the dominant taxa in some samples. The tubificid worms are indicative of nutrient-enriched low oxygen conditions that many other species do not tolerate. Low oxygen conditions may exist in and near the sediments, even though the water column is well oxygenated.

The phytoplankton community is limited by the turbid condition of the Río Uruguay, which limits light penetration. The dominant species are diatoms and nanoplanktonic phytoflagellates, which are characteristic of turbulent and turbid environments. Blue-green algae also comprise a significant portion of the phytoplankton community, particularly in the summer months when algal blooms can occur. Green algae are present but less important.

The zooplankton community on the Río Uruguay consists of micro-crustaceans and rotifers, with larval forms of other invertebrates also numerically important. These larval forms are dominated by golden mussel larvae, but also include larvae of snails and hydroid coelenterates.

3.2.6 Contaminants in Aquatic Biota

Levels of contaminants in fish tissues in the vicinity of Fray Bentos were investigated by Tana (2005, 2006), and provide a baseline for chemicals of interest with respect to mill operations. These include dioxins and furans in fish flesh. In addition, CARU (2005b) has sampled fish flesh for levels of PCBs and organochlorine pesticides. All concentrations were below levels of concern for fish consumption.

3.3 Overview of the Social Setting

The area of the CIS encompasses the eastern Uruguayan departments of Río Negro, Soriano and Paysandú as well as the Río Uruguay littoral in the Argentine department of Gualeguaychú. This entire area is characterized by a relatively homogeneous population concentrated in a small number of urban centers situated among large areas of farmland, cattle pasture and forest plantations. The following section summarizes the key findings of a Social Assessment of this area, which is attached as Annex E.

Table 3.3-1 illustrates the population and population density of the four departments compared to the national populations of both countries. Within these departments there is a high concentration of population in urban areas, with almost nine out ten persons residing in cities or towns. The capital cities of Río Negro (Fray Bentos) and Soriano (Mercedes) account for about half of their respective departmental populations; three quarters of the departmental population of Paysandú and Gualeguaychú, live in the capital cities, which carry the same name as the departments.

Table 3.3-1: Population and Population Density in Paysandú, Río Negro, Soriano and Gualeguaychú

Location	Area (km^2)	2004 Population (000)	Population Density (per km^2)
Uruguay	175,016	3,164	18.1
Paysandú	13,922	113	8.1
Río Negro	9,282	54	5.8
Soriano	9,008	85	9.4
Argentina	273,699	36,577	13.4
Gualeguaychú	7,086	101	14.3

The age profile of the population is similar among all four departments with approximately half the population being 30 years or older. Each department shows a similar breakdown of population by sex, with a slight predominance of men in Río Negro and of women in Paysandú, Soriano and Gualeguaychú. However there are significant differences in the relative numbers of men and women according to the urban/rural location of the population: in urban areas there is a similar proportion of men and women; in rural areas men predominate, for example, by as much as 1.6:1.0 in Paysandú. Population forecasts for the Uruguayan departments to 2025 by the National Institute of Statistics show very low rates of population growth and a relative decline in the rural population, conforming to long-term national trends of steadily increasing urbanization.

Quality of life indicators – including rates of poverty, literacy, infant mortality, access to drinking water and sanitation – in all four departments are relatively high in comparison to other Latin American countries. Measured in terms of the United Nations Index of Human Development (IHD)[1], Uruguay ranked 46th of 177 countries with an IHD of 0.833 (including rankings of 0.837 for Río Negro, 0.835 for Soriano and 0.831 for Paysandú, respectively, with the top ranking equal to 1.00). The latest available disaggregated data for Argentina (1999) shows an IHD of 0.826 for the entire country and 0.801 for the province of Entre Ríos in which the department of Gualeguaychú is located. Life expectancy in the three Uruguayan departments averages 74.5 years and 71.6 years in Gualeguaychú.

While literacy rates are high in all departments (averaging 97.7%), only an average of 22.3% of the population fourteen years and older have completed primary school and only 20% have completed secondary school in the three Uruguayan departments. In Gualeguaychú, the comparable levels of population over 15 years of age having completed primary school is nearly 50%, and the percentage having completed secondary school is nearly 23%.

Table 3.3-2 illustrates household income in the three Uruguayan departments compared to levels recorded for the national capital. Household income levels in these departments are somewhat lower than the average for Latin American countries as a whole, which may in part be attributable to the economic crisis of 2002.

[1] The UN Human Development Index (HDI) is a comparative measure of poverty, literacy, education, life expectancy, and other factors for countries worldwide. It is a standard means of measuring well-being, especially child welfare. The index has been used since 1993 by the United Nations Development Programme in its annual report.

Table 3.3-2: Comparison of Monthly Household Income in CIS Study Area, 2004 (in current USD)

	Average	Median
Uruguay	702	509
Montevideo	853	617
Paysandú	556	447
Río Negro	476	395
Soriano	623	437
Argentina	1,285	-
Buenos Aires	1,394	-
Gualeguaychú	-	-

Approximately 56% of the population of the three Uruguayan departments is economically active while 68% of the Gualeguaychú department is economically active. There are large differences in unemployment between Río Negro and the other departments. The unemployment rate for Río Negro is 3.6% of the workforce, whereas in Paysandú it is 16.3% of the workforce and in Soriano the unemployment rate reaches 16.9% with a significantly higher 27% reported for Gualeguaychú.[2] An occupational profile of the area reveals that 22.4% of the active workforce in Gualeguaychú is employed in the public sector. The corresponding figures in Uruguay are: 21.4% for Río Negro, 17.7% for Paysandú, and 17.6% for Soriano.

In terms of employment, the service sector is by far the most significant employer with an average of 70% of the active workforce of the four departments employed in this sector, which includes transportation, hotels and restaurants, banking, domestic service and retail trade. About 20% of the workforce is employed in the industrial sector (including manufacturing, construction and public utilities) and agriculture (farming, cattle ranching, forestry, hunting) accounts for the remaining 10%.

A much larger percentage of the population in the three Uruguayan departments are living at or below the poverty line than in Gualeguaychú (see Table 3.3-3). This assessment of impoverishment is based on the Unsatisfied Basic Needs method, which measures the extent to which the population is deprived of one or more basic needs including characteristics of housing, access to water and sanitation, access and achievement of education, dependency rate and other income-related indicators.

[2] Unemployment rate recorded in 2001, i.e., during the Argentine financial crisis.

Table 3.3-3: Percentage of Population and Households with Unsatisfied Basic Needs

Department	Percentage of Population	Percentage of Households
Paysandú	32	22
Río Negro	17	10
Soriano	27	17
Gualeguaychú	11	13

An indicator associated with the incidence of poverty in the area is the existence of irregular settlement or non-permanent housing. The percentage of resident population living in irregular settlements is close to zero in the three departments. Soriano presents the largest figure (0.08%) twice that of Paysandú (0.04%) and is four times greater than for Río Negro (0.02). The population living in irregular settlements is concentrated on the margins of urban centers. There are only two locations in Río Negro that have irregular settlements, three in Paysandú, and one in Soriano. In the two last departments, only the capital city has irregular settlements.

4.0 CUMULATIVE IMPACT ASSESSMENT

Cumulative impact assessments include the potential effects associated with existing projects and conditions, those of the proposed projects, and those of other developments that are realistically defined at the time the assessment is prepared and would impact directly on the project area.

The projects' area of influence includes the primary project sites and related facilities; associated facilities that are not funded as part of the project but whose existence depends exclusively on the project and whose goods or services are essential for the project; areas potentially affected by cumulative impacts; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later in time or at a different location. The area of influence considered in this study is the western Uruguayan departments of Río Negro, Soriano and Paysandú as well as the Río Uruguay littoral of the Argentine department of Gualeguaychú.

For this CIS, the primary projects considered are the Orion and CMB pulp mills under development by Botnia and ENCE, respectively, and their associated facilities and areas of influence as described in their disclosed EIAs.

Additional projects or facilities have been incorporated into this CIS on an individual basis by discipline, based upon the judgments of the team members in that discipline. For example, the discharge from the Fray Bentos domestic waste water collection system has been included in the water quality assessment due to its significance in the existing environment, the possibility that it could be upgraded in conjunction with project development, and its implications for cumulative impacts on the aquatic environment in the vicinity. The Kemira plant has also been included as a component of the Botnia mill to account for its potential emissions, energy balance, and potential benefits associated with production of chemicals for third parties.

The temporal boundaries for this CIS are provided by the major milestones in the projects' life cycles. The significant steps in their life cycles include: feasibility and detailed design; construction; operation and maintenance; and decommissioning. The timelines of the two proposed projects are not synchronous. One is under active construction and believed to be 1 or 2 years ahead of the other at the time of writing, although both companies had completed their EIAs for disclosure by mid-2005. Present expectations are that Botnia will be prepared to start operation of the mill in 2007 and ENCE would start up in 2009.

A forty year life for the plants has been adopted for this CIS, though the actual life of the plants may vary depending upon technological and economic developments that cannot be reliably predicted this far in advance. Decommissioning has not been considered in detail in this study for similar reasons; there is ample time during the projects' lives to develop and implement an appropriate decommissioning plan if and when required.

Finally, accidental or emergency events have not been included in this CIS due to their infrequent and unpredictable nature. Both companies have prepared emergency response plans for such unpredictable events and are making the necessary preparations for their implementation at the appropriate phase of the projects' development (prior to start-up). The individual project EIAs present each company's emergency preparedness and response plans as of the time of their release. DINAMA requires finalization and approval of such plans prior to issuance of an operational permit.

4.1 Methodology

4.1.1 CIS Process

The CIS process began in 2005 following the release of the individual project environmental and social impact studies and associated stakeholder consultations, at which time, the IFC decided that further study was required to assess the cumulative effects of the two pulp mills. The IFC contracted Pacific Consultants International (PCI) to complete the draft CIS report and contracted the Consensus Building Institute to conduct a stakeholder assessment. Further specialists and resources were contracted by PCI during the preparation of the draft CIS report. Among these specialists was a team of Uruguayan and Argentine social scientists commissioned to undertake a social assessment of Paysandú, Río Negro, Soriano and Gualeguaychú departments to strengthen the socio-economic baseline data considered in the CIS. In addition, Malcolm Pirnie Incorporated was retained to provide expertise on air and water modeling. IFC also retained a specialist consultant/advisor with expertise in cumulative impacts assessment to assist with the CIS.

Several developments influenced the CIS process. The conflict between Argentina and Uruguay concerning the two mills escalated since the release of the draft CIS and has affected diplomatic relations, transportation, trade and tourism between the two countries. Opponents of the two pulp mills on both sides of the river are concerned that the pulp mills will harm human health, the environment and the region's economy. Opposition by residents of Argentina has included blocking routes to international bridges, with the longest blockade lasting 45 days during the summer holiday season of 2005/2006. In addition, numerous smaller demonstrations in Gualeguaychú, legal actions against the companies in Argentine courts as well as two very large demonstrations involving many thousands of primarily Argentine residents took place in April of 2005 and 2006 on the international bridge. Other manifestations of Argentine opposition have included a complaint filed with the Compliance Advisor/Ombudsman of IFC and MIGA, a number of letters to World Bank Group officials requesting suspension of consideration of pending loans, and putting pressure on potential financial supporters of the projects including export credit agencies and commercial banks.

On May 4, 2006, Argentina filed an Application initiating proceedings before the International Court of Justice (ICJ) against Uruguay claiming that Uruguay breached its duty under the 1975 Statute of the Río Uruguay to consult with Argentina before authorizing the

construction of two pulp mill projects on the Uruguayan side of the Río Uruguay. Argentina's Application to the Court was accompanied by a request for the indication of provisional measures in the form of an Order that, pending the Court's final judgment, Uruguay suspend forthwith all authorizations for the construction of the two paper mills, take all necessary measures to suspend all construction work, and cooperate with Argentina to protect and preserve the aquatic environment of the Río Uruguay. On July 13, 2006, the ICJ issued an Order rejecting Argentina's request for provisional measures. The ICJ was not persuaded, based on "the circumstances as they now present themselves to the Court," that the construction of the mills presents irreparable damage to the aquatic environment of the Río Uruguay, or that the threat of any pollution is imminent. However, the Court noted that the mills are not yet operational and made clear that by proceeding with the work Uruguay "necessarily bears all risks relating to any finding on the merits that the Court might later make" and that the construction of the mills at the current site cannot be deemed to create a fait accompli. The Court also noted that its decision "leaves unaffected the right of Argentina to submit in the future a fresh request for the indication of provisional measures" based on new facts.

In September 2005, the Centre for Human Rights and Environment (Centro de Derechos Humanos y Ambiente, CEDHA) filed a comprehensive complaint to the World Bank's Office of Compliance Advisory Ombudsman (CAO). The complaint was filed on behalf of the Entre Ríos Governor, the Citizens Environmental Assembly of Gualeguaychú and nearly 40,000 other signatories. Among a range of concerns articulated, the complaint requested that the CAO examine whether appropriate process was followed in the preparation of mill-related environmental and social assessments, whether the views of and issues raised by concerned citizens—particularly in Gualeguaychú—were taken into account, and asked that the CAO audit the extent to which IFC had complied with its environmental assessment requirements and other related policies. The complaint also alleged that the Government of Uruguay had not complied with the Rio Uruguay Treaty.

Some of the key findings of the CAO included: that there were shortcomings in the earlier consultation process concerning the projects, particularly a lack of adequate engagement with concerned citizens in Gualeguaychú; that concerns regarding impacts of the plants on tourism and fisheries had not been adequately covered in the project EIAs; that efforts to build trust were necessary; and that there should be a transparent consultation process to help define the terms of reference and scope of the CIS. Among other steps, the CAO recommended that a cumulative assessment process already underway continue and that it should thoroughly address stakeholder concerns and include more specific information on plant technology and related environmental impacts (and how they relate to best practice in the industry). Subsequently, CAO encouraged all parties to participate in the consultation process associated with the draft CIS. The CAO then undertook a subsequent audit which was released in February 2006 which found that IFC had prematurely agreed to release of the project EIAs prior to an adequate cumulative impact study being conducted and recommended that procedures be implemented related to posting and updating of documentation on external websites, collaboration of IFC and MIGA, and completion of all

material environmental impact assessment (in this case cumulative impact assessment) prior to public disclosure.

The draft CIS and the Consensus Building Institute (CBI) stakeholder assessment were released in December 2005. As noted in the CBI assessment, various stakeholders declined participation stating that the terms of engagement needed to be clarified and the assessment process was rushed. In recognition of the shortcomings of the previous consultation process, and to ensure thorough coverage of stakeholder concerns in a final CIS, IFC opened a 60-day consultation period on December 19, 2005 to receive feedback from stakeholders on the scope, methodology and findings of the draft CIS. With the intent of implementing a transparent and meaningful public engagement process, the IFC developed an approach to consultation that included: making the draft CIS available for public review; obtaining written stakeholder feedback through an online submission mechanism or by mail and by convening several meetings in Uruguay and Argentina facilitated by an independent third party (January/February 2006); inviting the governments of Argentina and Uruguay to nominate technical experts to assess stakeholder concerns; making the terms of reference for the role of the experts and the experts' findings and recommendations available to the public; and through public release of an action plan to respond to the experts' findings and recommendations and which specified the remaining steps in IFC's due diligence and decision-making process.

More than 100 written comments were submitted during the consultation period and posted on the IFC website (www.ifc.org/ifcext/lac.nsf/Content/Uruguay_PulpMills_Consultation) as well as the transcript of the consultation meetings held in the two countries. Members of the expert panel were drawn from among a pool of technically qualified nominees by IFC following the decision by both Governments to decline the opportunity to nominate a panelist. The expert panel reviewed the feedback received, as well as all existing project related documentation and presented their findings to IFC. The independent expert panel report, referred to as the Hatfield Report, was released in April 2006 and provided recommendations for the revision of the draft CIS in response to identified stakeholder concerns and their own professional judgment.

For the final phase of the environmental due diligence process, the IFC released an action plan in May 2006 that identified key issues to be addressed in the revised CIS. The action plan indicates that the revised CIS will be reviewed by the expert panel to verify consistency and responsiveness to the recommendations in the Hatfield Report. This review process is designed to ensure that stakeholder concerns, as identified by Hatfield, are addressed in the final CIS. The publicly released terms of reference provided additional direction for the CIS revision. The final CIS will be released to the public for 30 days upon completion prior to any potential consideration of the projects by IFC's and MIGA's Board of Directors.

Following a competitive bidding process among pre-qualified environmental consulting firms, EcoMetrix Incorporated (EcoMetrix) was retained by the IFC in July 2006 to revise and finalize the draft CIS. Revisions were completed in response to the recommendations

of the Hatfield Report, the published Terms of Reference, original research by the CIS project team, stakeholder commentary and other project related documentation. The Terms of Reference for the original and the revised CIS can be found in Annex H of this report.

4.1.2 Public Consultation and Engagement

Public engagement assisted in the scoping and focusing of the contents of the draft CIS and became more comprehensive and structured upon public release of the draft in December 2005. The environmental policy requirements which apply to the pulp mills are those which were in effect at the time IFC initially appraised the pulp mills in 2004/05. These policies indicate that public consultation and disclosure activities are integral components of the EIA process for projects that IFC finances. In this respect, both Botnia and ENCE carried out consultation activities in support of their EIA activities for their respective projects. Table 4.1-1 summarizes the two projects' consultation and disclosure activities between July 2002 and November 2005. The consultations listed were carried out, in part, to comply with Uruguayan environmental assessment disclosure and consultation requirements for their projects but also, according to the sponsoring companies, to promote understanding and build support for the projects among concerned and interested parties in Argentina and Uruguay.

As part of the CIS process, IFC contracted the Consensus Building Institute (CBI) – a non-profit organization specializing in facilitated dialogues, mediation and negotiation – to carry out an additional independent assessment of stakeholder perceptions and concerns about the mills and recommend strategies for possible stakeholder dialogue. The purpose of the assessment was to: better inform the IFC and other stakeholders about the range and depth of stakeholder concerns and perceptions regarding the mills; and recommend potential ways to engage stakeholders in a dialogue and a review of the draft CIS.

The stakeholder assessment reflects more than 80 interviews with a diverse range of stakeholders related to the proposed mills. CBI conducted most interviews during the final weeks of November in the two populated areas closest to the proposed plants, Fray Bentos, Uruguay, and Gualeguaychú, Argentina, and in Montevideo, Uruguay; Buenos Aires, Argentina; and Washington, DC. CBI's team of six assessors included two from Argentina, one from Uruguay and three from the United States.

CBI sought to interview stakeholders representing the full range of opinions about the mills. CBI identified and spoke with civil society groups, non-governmental organizations (NGOs), business associations, public officials, and interested citizens such as tourism operators, local business owners, fishermen, farmers and plantation owners. CBI also spoke with IFC and representatives of Botnia and ENCE. Several stakeholders who oppose the mills declined interview requests, citing concerns that IFC had not established clear terms of engagement for stakeholder consultation.

The stakeholder assessment revealed a sharp divide between stakeholders who are optimistic about jobs and economic development stemming from the mills and stakeholders who see the projects as a fundamental threat to the environment, tourism, agriculture, fishing and their overall quality of life. CBI grouped stakeholder concerns and perceptions into the following areas:

- economic development and job opportunity;
- community quality of life;
- eucalyptus plantations and changing land use;
- effects on fishing and agriculture from pollutants; and
- appropriateness of proposed plant sites, controls and monitoring.

CBI also asked stakeholders about their perceptions of a possible joint review of the mills' impacts. Many stakeholders said a joint review of the draft CIS might offer a useful opportunity to address their concerns and issues. However, many other stakeholders were skeptical, and said they would require assurances that joint review of the mills impacts would be meaningful and transparent; include broad stakeholder representation; provide opportunity for the review of all credible information; and respect sovereignty and community self-determination.

The CBI assessment notes that those stakeholders most optimistic about the mills' positive impacts and those most concerned about their negative impacts had become highly polarized and mutually distrustful. In order for the joint review to be productive, it needed to be based on explicit commitments from the concerned national and sub-national governments, IFC, the companies proposing to build the mills, and civil society stakeholders in both Uruguay and Argentina to engage in a good faith effort to resolve substantive questions about the mills impacts, and to explore the full range of siting, design, construction and operational options.

The findings of CBI's stakeholder assessment are summarized below in Table 4.1-2 and the full assessment report is attached as Annex G to this report. These findings are generally consistent with the views that have been expressed by stakeholders in earlier consultations undertaken by each of the companies as well as with representations made by public interest groups to IFC regarding project concerns subsequent to the disclosure of the EIA documentation for both projects. Subsequent to the public disclosure of the draft CIS, CBI issued its recommendations for public engagement between IFC, the companies and stakeholders in the review of the draft CIS findings. These recommendations, along with the technical analysis of the degree and range of expected cumulative impacts, helped guide the process of further engagement.

In addition, the Office of the IFC/MIGA Compliance Advisor Ombudsman (CAO) also met with a significant number and diverse representation of stakeholders in response to a complaint received on September 23, 2005. The complaint alleged that the projects will

create toxic, noxious emission incompatible with tourism and agriculture and also raised concern about the regulatory capacity to monitor and enforce environmental standards[5].

The polarization of stakeholder views regarding the pulp projects and decision by some in Argentina not to fully participate in consultations has led to allegations that the process was not thorough or adequately participatory. However, the volume and diversity of comments offered in a large number of different forums, the extensive written documentation of stakeholder concerns received, and the expert panel's review of those concerns suggests that issues of relevance are now well-known. Subsequently a good faith and professional effort has been made by the CIS project team to address these concerns within this revised CIS.

With respect to stakeholder views and engagement, however, it is important to indicate that large numbers of Argentines , particularly those living within the community of Gualeguaychú and affiliated environmental NGOs, most notably ACAG and CEDHA, as well as the Government of Argentina remain opposed to the mills in their present location and continue to vigorously pursue this opposition via the International Court of Justice, deliberations of the World Bank Group, commercial lenders, and the Organization for Economic Cooperation and Development among others.

4.1.3 Analysis of Cumulative Impacts

This study has employed a number of specialized techniques and methodologies for the analysis of cumulative impacts by discipline. Several of these are described in the annexes to this report in addition to those described herein. They include sophisticated, internationally accepted computer modeling techniques for the analysis of air emissions and effluents to water. Other methodologies used are quantitative to the extent that is feasible in the given discipline and within the constraints of this particular study, while other methodologies are qualitative in nature and rely significantly on the judgments of experienced expert(s) on the CIS project team. The project team (listed in Table 1.7-1) includes senior professionals with most having advanced degrees (Master or Doctorate level), twenty or more years of experience within their respective discipline, and experience specifically relating to pulp and paper technologies and environment assessment.

4.1.3.1 Methodology for Assessment of Air Quality

The assessment of air quality and related impacts of pulp mill emissions primarily involved mathematical modelling of atmospheric dispersion, and the prediction of ground level ambient air quality for comparison to air quality criteria. The assessment was supported by

[5] Information on the activities of the CAO with respect to these projects can be found at the following web site: http://www.cao-ombudsman.org/html-english/complaint_cmb.htm.

a literature review of human health and odour effects associated with common air emissions.

Models are widely used to support the assessment of air quality effects since they can reliably calculate the change in air quality based on the emissions from the mills and on fundamental laws of physics, chemistry and mass conservation. They provide the only viable means to estimate change under a wide range of meteorological conditions especially when the infrastructure being evaluated has not yet been built.

Two types of models were utilized for this assessment – meteorological models and air dispersion models.

Meteorological models were used to augment the available meteorological data to provide a complete representation of the three-dimensional wind field within the general area of the mill sites. The assessment was completed using CALMET coupled with a non-hydrostatic meso-scale weather forecast model referred to as FReSH (Radonjic, 2005). The modeling approach involved three main steps. First, weather predictions were obtained at six-hour increments from the United States National Center for Environmental Prediction (NCEP) over a coarse grid that extended over the Southern portion of South America. Second, FReSH utilized the NCEP data to generate a three-dimensional wind field at hourly intervals over a 3.3 km square grid within the general region of the proposed mill facilities. Third, the CALMET model was used to refine the predicted wind field to a 200 m square grid within a 60 by 40 km area centered on the two mill sites.

Air dispersion models were used to predict the change in ground level air quality attributed to the air emissions from the mill operations. Two air dispersion models were used for this assessment – the Industrial Source Complex Short Term version 3 (ISCST3) model and the CALPUFF model. These models are widely used and accepted, and, in the case of CALPUFF, considered state-of-the-science. Both models are approved by the United States Environmental Protection Agency (USEPA) and are available within the public domain. Prior model investigations of the two mills utilized the ISCST3 model (Algoritmos, 2006; Malcolm Pirnie, 2005), and as per the original terms of reference, this model is also used in the present investigation to support the assessment of potential air quality impacts for the two mills. However, in recognition of concerns raised by various stakeholders, the CALPUFF model has also been utilized to account for potential uncertainty in the ISCST3 model. Both models support the same conclusions regarding air quality.

The analysis of ground level ambient air quality utilized the predicted hourly wind field for the 2004 period. Figure 4.1-1 provides a comparison of the predicted and measured wind roses. Based on this comparison, it is concluded that the predicted wind field provides a suitable representation of the winds near the two mill sites. The wind roses show that the dominant wind direction is from the north to northeast quadrants. When winds blow from this direction atmospheric discharges will be carried in a south to southwesterly direction, and therefore not towards Gualeguaychú or neighboring sites on the Argentine side of the Río Uruguay.

Ambient air quality results were considered at specific locations of interest (receptor locations). These locations included:

- Air Receptor 1, area immediately adjacent to the mill properties, Uruguay;
- Air Receptor 2, city of Fray Bentos, Uruguay;
- Air Receptor 3, city of Mercedes, Uruguay;
- Air Receptor 4, city of Nuevo Berlin, Uruguay;
- Air Receptor 5, beach area at Las Cañas, Uruguay;
- Air Receptor 6, beach area at Playa Ubici, Uruguay;
- Air Receptor 7, International Bridge, Uruguay;
- Air Receptor 8, city of Gualeguaychú, Argentina;
- Air Receptor 9, beach area at Ñandubaysal, Argentina; and
- Air Receptor 10, near the International Bridge, Argentina;

The impacts on ambient air quality at each of these receptors is discussed in Section 4.4 below.

4.1.3.2 Methodology for Assessment of Water Quality

The assessment of water quality and related impacts of pulp mill effluents on the Río Uruguay primarily involved mathematical modelling of effluent dispersion in the river to determine resulting concentrations of effluent constituents, for comparison to water quality guidelines and existing baseline concentrations. The assessment was supported by review of literature pertinent to some water quality concerns, particularly dioxins and furans, endocrine disrupting compounds, and chemicals associated with fish tainting. The assessment of sediment quality impacts was based on consideration of the potential for change in water quality, including suspended sediment loads, and on consideration of the conditions required for sediment mobilization.

Two types of mathematical models were utilized in calculating effluent dispersion and concentrations of effluent constituents in the Río Uruguay. Near-field models predict water quality changes near to the point of effluent discharge, based on the diffuser configuration and discharge characteristics, such as effluent temperature, density and release rate, as well as local river geometry, diffuser and river depth, river flow and temperature, etc. Far-field models predict water quality changes farther from the point of discharge, beyond the initial mixing zone, based on the hydrodynamics, bathymetry and shoreline geometry of the river. This approach is widely used for the management of water quality within many regulatory jurisdictions in South America, North America and Europe.

Two near-field models were utilized. The CORMIX model developed by Cornell University (Akar and Jirka, 1990) was used as the primary near-field modelling tool. The VPLUME model distributed by the U.S. Environmental Protection Agency (Frick *et al.*, 2001) was used to provide a cross-check on the CORMIX model results, to ensure that the analysis was valid and conservative.

The far-field modelling was performed using the TABS-MD series of models, available from the U.S. Army Corps of Engineers. Specifically, RMA-2 and RMA-10 are two- and three-dimensional finite element hydrodynamic models. RMA-2 computes the lateral and longitudinal distribution of water surface elevation and horizontal velocity, while RMA-10 includes the vertical distribution of velocity to enable assessment of stratified waterbodies. RMA-11 is a water quality sub-model, a three-dimensional finite element model capable of calculating the transport, dispersion and fate of water quality constituents, using the hydrodynamic results from RMA-2 or RMA-10.

The implementation of the models is described in Annex D, Section D5.1, and is briefly summarized here. Bathymetric data for the Río Uruguay were taken from published hydrographic charts. Hydrodynamic input data included river flow data at the Salto Grande dam, and water elevation data at Las Cañas. Wind data were utilized from various stations along the Río Uruguay.

The far-field hydrodynamic model was calibrated by comparing predicted and measured water elevation data for various locations along the Río Uruguay, for 05 to 25 January 1997, and adjusting the model's coefficient of roughness to maximize agreement between observed and predicted values. The calibrated model was then validated by running it for a different period (05 to 25 February 1997) in which flow conditions at the Salto Grande dam were quite different and again comparing observed and predicted water elevations. It was concluded that the hydrodynamic model accurately predicts flow dynamics along the Río Uruguay below the Salto Grande dam.

Baseline water quality conditions in the Río Uruguay were taken from Algoritmos (2006). These are average concentrations of key water quality parameters based on five water samples collected at each of ten river locations in 2005, under near average flow conditions. The locations ranged from upstream of the proposed ENCE discharge to Balneario Las Cañas.

The physical characteristics of the effluent discharges (diffuser configurations) were provided by Botnia and ENCE (Table 4.1-3). The chemical characteristics of the effluents were also provided by Botnia and ENCE. They are summarized in Table 4.1-4 as annual average and monthly maximum values, generally loadings per air dry ton (ADt) of production. These loadings were multiplied by 1,000,000 ADt/year for the Orion mill, and 500,000 ADt/year for the CMB mill, to estimate the substance release per year.

The modelling was completed for different river flow and effluent discharge scenarios, including: typical river flow (6,230 m^3/s) and monthly maximum mill discharge; extreme low river flow (500 m^3/s) and monthly maximum mill discharge; and river flow reversal (rare) and monthly maximum mill discharge. Various wind conditions under low flow conditions were also investigated.

For each of these scenarios, water quality results were considered at specific river locations of interest (receptor locations). These locations included:

- Water Receptor 1, Río Uruguay at the Botnia and ENCE diffusers, Uruguay;
- Water Receptor 2, Río Uruguay at Yaguareté Bay, Uruguay;
- Water Receptor 3, Playa Ubici at Yaguareté Bay, Uruguay;
- Water Receptor 4, Fray Bentos drinking water intake, Uruguay;
- Water Receptor 5, beach area near Arroyo Fray Bentos, Uruguay;
- Water Receptor 6, beach area at Las Cañas, Uruguay;
- Water Receptor 7, Río de la Plata, Uruguay;
- Water Receptor 8, Río Uruguay Island Delta, Uruguay;
- Water Receptor 9, Río Negro, Uruguay;
- Water Receptor 10, Río Uruguay on the Argentina side; and
- Water Receptor 11, beach area at Ñandubaysal, Argentina.

Several project options were also considered, in terms of effect on the combined mill loadings to the Río Uruguay. These included the option to treat the Fray Bentos municipal effluent within the Botnia mill effluent treatment system. The impact on water quality at each of these receptors is discussed in Section 4.6 below.

Table 4.1-1a: Disclosure and Consultation Activities for ENCE

Type*	Participants	Year	Date	Location
A	Senate's Environmental Commission	2002	15-July	Montevideo
B	Forest Producers Association	2002	16-July	Montevideo
A	Minister for Housing, Planning, Env, DINAMA	2002	17-July	Montevideo
A	City Mayor and Río Negro Representatives	2002	18-July	Fray Bentos
D	CARU	2002	19-July	Paysandú
D	Departmental Councils	2002	19-July	Las Cañas
B	Eufores Local Staff	2002	19-July	Fray Bentos
E	Local Press	2002	20July	Fray Bentos
C	Local Environmental NGOs	2002	20-July	Fray Bentos
C	Trade Union Association Panels	2002	22-July	Montevideo
D	Technicians/academics (Pulp Seminar)	2002	26-27 July	Montevideo
A	DINAMA	2002	November	Montevideo
C	Open house	2002	June-July	Fray Bentos
D	Public Hearing	2002	21-July	Fray Bentos
E	Television Espanola	2005	20-January	
A	Agregados Navales	2005	04-March	
A	Transport Minister and commission	2005	03-April	Montevideo
D	Pulpwood Conference	2005	14-April	Montevideo
A	Canadian Ambassador and Comission	2005	26-April	
C	Radio Interview/Gualeguaychú	2005	9-May	Gualeguaychú
A	Deputies from PP Movement	2005	20-May	
A	Deputies from PP Paysandú/Nacional	2005	03-June	
A	Spanish Diplomatic Commission	2005	06-June	
A	Deputies Patrone and Varela	2005	21-June	
A	Uruguayan Diplomats	2005	July	Montevideo
E	Media of Montevideo	2005	11-August	
A	Meeting with Senator Rafael Michelini	2005	12-August	
D	Reps of CARU and Forest Producers Society	2005	17-August	
A	National Administration of Ports	2005	22-August	Montevideo
D	Stakeholder consultations with IFC	2005	28 Aug-Sept 2	
B	FEMESA Assoc of Spanish Companies in UR	2005	30-August	Montevideo
A	Comission of Environmental Deputies	2005	31-August	
D	Participation in the Rural Exhibition in Prado	2005		Prado
E	Participation on TV Program Americando	2005	August	
A	Comission for Labor Deputies	2005	09-September	
A	Junta Departamental Paysandú	2005	21-September	Paysandú
E	Interview with BBC Journalists	2005	28-September	
A	Minister of Labor and Commission	2005	30-September	Montevideo
A	Deputies Mañana and Borsari	2005	20-October	Montevideo
A	President of Uruguay	2005	21-October	Montevideo
A	Senate's Environmental Commission	2005	26-October	Montevideo
A	Consulate for Spain	2005	28-October	
A	BID Directory	2005	03-November	
A	Directory of Antel	2005	07-November	

Table 4.1-1b: Disclosure and Consultation Activities for Botnia

Type*	Participants	Year	Date	Location
D	Presentation to Labour Union	2003	12-January	Montevideo
C	Presentation to Local hospitals, schools, Police	2003	12-February	Fray Bentos
D	First Public Forum	2003	12-February	Fray Bentos
A	Informing environmental authorities of Argentina	2003	11-March	Buenos Aires
A	Delegation visit to Finland	2003	04 to 08-April	Finland; Helsinki
C	NGO meetings	2003	11-April	Montevideo
D	informative Meeting	2003	11-May	Fray Bentos
D	Public Conference	2003	12-October	Montevideo
A	First Approach EIA; DINAMA	2003	17-October	Montevideo
A	First Approach CARU	2003	21-October	Montevideo
E	Send to all media	2003	24-October	Montevideo
A	First meeting with CARU	2003	October	Montevideo
A	Presentation to Paysandu Governor; Mayor Lamas	2003	28-October	Paysandú Municipality
A	Presentation to Soriano Governor; Mayor Centurion	2003	28-October	Rio Negro Municipality
E	Press conference	2003	30-October	Montevideo
E	TV Program	2003	14-Nov	Montevideo
D	Labour Union meeting	2003	24-Nov	Montevideo
A	CARU meeting	2003	November	Montevideo
A	Meeting with CARU	2003	December	Montevideo
A	Meeting with Rio Negro Major	2003	12-December	Fray Bentos
B	Meeting with Fray Bentos Port Authorities	2003	December	Fray Bentos
D	Public presentation of the project	2003	11-13-December	Paysandú
E	Press Interview	2003	15-December	Montevideo
D	Seminario on Ethics IDB	2003	18-December	Montevideo
A	IDB Meeting	2003	19-December	Montevideo
A	Meeting with CARU	2004	16-January	Montevideo
E	Journalist tour to Finland	2004	February	Finland
A	Meeting with Authorities	2004	03-February	Fray Bentos
C	Meeting with firefighters authorities	2004	03-February	Fray Bentos
D	Second Public Forum	2004	03-February	Fray Bentos
E	TV Interview	2004	06-February	Montevideo
B	Scientifics Seminar	2004	03-March	Las Cañas
D	informative Meeting	2004	03-March	Mercedes
B	Scientifics Seminar	2004	03-March	Montevideo
E	Press Interview	2004	03-March	Montevideo
E	Radio Interview	2004	09-March	Montevideo
E	Radio Interview	2004	11-March	Montevideo
D	Public Presentation of the Project	2004	13-March	Fray Bentos

Type*	Participants	Year	Date	Location
C	NGO meetings	2004	06-April	Fray Bentos
C	Meeting with Dean of Agronomy	2004	11-April	Montevideo
C	CEADU meeting	2004	11-April	Montevideo
A	meeting with Uruguayan Chanceller	2004	15-April	Montevideo
E	Press Interview	2004	22-April	Montevideo
E	Radio Interview	2004	12-May	Montevideo
A	Meeting with Politicians	2004	12-May	Montevideo
C	Meeting with Forest Directors of Misiones Argentina	2004	14-May	Montevideo
D	informative Meeting	2004	26-May	Fray Bentos
D	informative Meeting MODESA	2004	May	Montevideo
E	Press conference	2004	27-May	Montevideo
E	Radio Interview	2004	28-May	Montevideo
E	Radio Interview	2004	31-May	Montevideo
C	NGO meetings	2004	03 to 08-June	Montevideo
C	Communication meeting with Forestry Division Sector, University and Unions	2004	03 to 05-June	Montevideo
A	Presentation of the Project to the Chamber	2004	07-June	Montevideo
C	Meeting with UTU	2004	11-June	Mercedes
E	Radio Interview	2004	11-June	Montevideo
E	Radio Interview	2004	14-June	Montevideo
A	Meeting with CARU president	2004	21-June	Buenos Aires
E	Journalist tour to Finland	2004	28-June	Finland
D	Informative meeting	2004	06-July	Montevideo
A	Presentation of the EIA	2004	09-July	Montevideo
A	Meeting with CARU President	2004	27-July	Paysandú
E	Press Interview	2004	27-July	Fray Bentos
A	Meeting with Environmental Secretary	2004	29-July	Montevideo
A	Trip to Finland with CARU representative	2004	02 to 10-August	Finland
C	Meeting with Labour Union	2004	13-August	Montevideo
A	Meeting with CARU representative	2004	23-August	Montevideo
E	First Edition of Espacio Magazine	2004	August	Montevideo
E	Trip of Fray Bentos TV Chanel to Finland	2004	12 to 14-September	Finland
E	journalist visits to FOSA	2004	September	Paysandú
C	Meeting with Commercial Association from Fray Bentos	2004	11-October	Fray Bentos
A	Presentation of the EIA to CARU	2004	19-October	Paysandú
C	Meeting with CICEPLA	2004	21-October	Punta del Este
C	Meeting with Forest Stakeholders	2004	26-October	Montevideo
D	Presentation of the EIA in Concordia, Entre Rios, Argentina	2004	28-29-October	Entre Rios, Argentina
C	CEADU meeting	2004	02-November	Montevideo

Type*	Participants	Year	Date	Location
C	Meeting with Fray Bentos Priest	2004	11-November	Fray Bentos
E	TV Interview	2004	11-December	Montevideo
A	Finnish Industry Ministry delegation	2004	16-November	Montevideo
B	Seminar about wood and Technology	2004	17-November	Montevideo
A	meeting at the Uruguay-Argentina trade Chamber	2004	18-November	Montevideo
D	Botnia's information office before Public Hearing	2004	13-17-December	Fray Bentos
A	Meeting with environmental ministers of Uruguay and Finland	2004	16-December	Buenos Aires
C	Meeting with Labour Union Representative (training programs)	2004	18-December	Montevideo
E	Radio Interview	2004	20-December	Montevideo
C	Public Hearing	2004	21-December	Fray Bentos
C	Public opinion study	2004	December	Fray Bentos
C	Meeting with Metallurgical Union	2005	10-January	Montevideo
E	Radio Interview	2005	25-January	Montevideo
B	Potential financiers' meetings in Uruguay	2005	January-February	Uruguay
D	Presentation of project	2005	09-February	Concepcion del Uruguay
A	Environmental permit	2005	14-February	Montevideo
E	Journal Interview	2005	06-March	Fray Bentos
C	Meeting with Main Dean of the University - updating on the projects, training programs issues	2005	15-March	Montevideo
E	Press Interview	2005	29-March	Montevideo
B	First World Bank Mission	2005	31-March	Montevideo
B	IFC meetings in Uruguay for financing Botnia	2005	April	Uruguay
C	Meeting with labour Union representatives training issues	2005	05-April	Montevideo
D	Forest Forum (Papel Misionero)	2005	06-April	Misiones, Argentina
E	2nd Edition of the Magazine Espacio Botnia	2005	07-April	Fray Bentos
B	Meeting with Martín Aguerre	2005	07-April	Buenos Aires
A	New Mayor Ceremony	2005	07-April	Fray Bentos
A	Meeting with CARU	2005	15-April	Paysandú
C	Meeting with Labour Union Representatives	2005	19-April	Montevideo
C	Meeting with OSE water company	2005	19-April	Montevideo
A	Meeting with politicians	2005		Montevideo
C	Meeting with DNM (meteorologists of Uruguay)	2005	19-April	Montevideo
E	Press Interview	2005	23-April	Montevideo
E	Radio Interview	2005	26-April	Montevideo
E	TV program	2005	06-May	Fray Bentos
A	Meeting with Corrientes Governor, and Minister	2005	09-May	Corrientes, Argentina
B	Launching of FOSA nursery	2005	10-May	Paysandú

Type*	Participants	Year	Date	Location
E	Meetings with media in Gualeguaychú and Uruguayan consul	2005	10 to 13-May	Gualeguaychú
A	Construction site visit of the Environmental Commission of the Parliament	2005	16-May	Fray Bentos
A	Meeting at the Local Parliament	2005	23-May	Fray Bentos
D	Public forum	2005	24-May	Fray Bentos
C	Meeting with Labour Union	2005	25-May	Montevideo
D	Public Presentation of the Project	2005	26-May	Montevideo
D	Public Presentation of the Project	2005	27-May	Concordia
A	Dinama's letter to Finnish Government accepting technical expertise transfer	2005	05-June	Montevideo
A	Visit to the site Environmental Viceminister	2005	06-June	Fray Bentos
D	Informative meeting of Ontur (Nueva Palmira port)	2005	06-June	Nueva Palmira
C	Presentation at the Rural Society	2005	09-June	Montevideo
A	Meeting with OSE water company	2005	15-June	Montevideo
A	Meeting with DNM (meteorologists of Uruguay)	2005	15-June	Montevideo
C	Meeting with Labour Union representatives	2005	16-June	Fray Bentos
C	Meeting at AFOA (Argentinean Association of Forest Growers)	2005	23-June	Buenos Aires
C	Meeting with Autoconvocados President	2005	24-June	
B	Marketing and Entrepreneurial Association Meeting	2005	29-June	Montevideo
C	Meeting with Labour Union Representatives	2005	30-June	Montevideo
E	Press conference announcing the decision of the investment	2005	03-July	Montevideo
E	TV program	2005	06-July	Montevideo
D	Ontur Public hearing (Nueva Palmira port)	2005	21-July	Nueva Palmira
A	Meeting with CARU	2005	25-July	Montevideo
E	TV program local channel	2005	26-July	Paysandú
E	TV program national channel	2005	July	Montevideo
E	Press Interview	2005	July	Montevideo
C	Presentation at the Medical Labour Union	2005	28-July	Montevideo
A	Presentation at the University	2005	29-July	Concepcion del Uruguay
C	Presentation at the Commercial Association of Rio Negro	2005	30-July	Fray Bentos
A	Visit to the site Senator Eduardo Ríos	2005	07-August	Fray Bentos
D	Presentation of the project	2005	09-August	Corrientes, Argentina
A	Presentation at Seminar of the Accounting College	2005	18-August	Montevideo
A	Presentation to the Science and Technology Comission of the Senate	2005	22-August	Montevideo
A	Press Visit to Fray Bentos and the site	2005	23-August	Fray Bentos
A	Presentation at the University UTN	2005	25-August	Concordia
D	Stakeholder Consultations with IFC	2005	28-August to 2-September	Montevideo

Type*	Participants	Year	Date	Location
A	Visit of the Environment Commission of Deputies	2005	30-August	Fray Bentos
E	TV program	2005	31-August	Montevideo
E	TV program interview	2005	03-September	Montevideo
E	Radio Interview	2005	September	Montevideo
B	Presentation in Expo Activa (200 persons)	2005	04-September	Mercedes
E	Radio Interview from Gualeguaychú	2005	05-September	Gualeguaychú
A	Meeting with Deputies Comission of work and safety	2005	09-September	Fray Bentos
A	Senate Commission of Environment	2005	21-September	Montevideo
A	Presentation at the Forest Congress in Neuquén	2005	22-September	Neuquén
C	Presentation to Rotary Meeting	2005	24-September	Fray Bentos
C	Presentation at FUPIR	2005	29-September	Montevideo
C	Meeting with Labour Union representatives	2005	30-September	Montevideo
E	Press interview	2005	03-October	Montevideo
D	Public Presentation of the Project	2005	06-October	Juan Lacaze
E	Radio program	2005	08-October	Montevideo
A	Presentation at the Parliament "Environmental Comission of the Senate"	2005	07-November	Montevideo
C	Meeting at AFOA (Argentinean Association of Forest Growers)	2005	07-December	Buenos Aires
E	3rd Edition of the Magazine Espacio Botnia	2005	01-October	Fray Bentos
A	Regularly meetings with authorities and politicians from all parties in Uruguay	2005	Continues	Uruguay
E	Every Friday press release to local press, including Gualeguaychú	2005	Continues	Gualeguaychú
E	Monthly meetings with media	2005	Continues	Fray Bentos

Table 4.1-1c: Disclosure and Consultation Activities for Botnia-Forestry

Type	Participants	Year	Date	Location
D	Open day for the community	2002	08-May	Rio Negro
B	Visit to Nursery and Tres Bocas	2002	18-May	Rio Negro
C	Semminar environment and forestry	2002	20-May	Rio Negro
C	Visit to FOSA	2002	28-june	Rio Negro
C	Open day for the community	2002	26-july	Rio Negro
A	Courses launching MEVIR, JUNAE, DINAE, IMRN	2002	19-october	Rio Negro
C	Judging in Science clubs of Río Negro	2002	22-october	Rio Negro
A	Mafalda Tour for INIA Technicians	2002	20-november	Rio Negro
C	Visit to Nursery and Tres Bocas	2002	16-november	Rio Negro
B	training on prevention and control of forest fires	2002	22-november	Paysandu
C	Visit to El Pinguiño with Brussa, Grella and students	2002	23-november	Rio Negro
C	Visit to El Pinguiño with science students	2002	27-28-november	Rio Negro
C	visit to Nursery and Tres Bocas of Saint Catherine`s School	2002	29-november	Rio Negro
B	La Toribia -study of waste decomposition	2002	23-december	Rio Negro
B	Reunión Coordinación Taller de Estrés	2003	31-january	Paysandu
A	Studies at La Toribia with agronomic university	2003	29-january	Rio Negro
A	UNESO students training	2003	4-28-februrary	Paysandu
C	La Toribia -study of waste decomposition	2003	19-february	Rio Negro
A	Presentation of SSMA y FSC programe for local government of Paysandu	2003	15-march	Paysandu
C	Open day for the community	2003	23-May	Paysandu
A	Faculty of agronomics to the nursery	2003	28-May	Paysandu
B	SSMA meeting with harvesting teams	2003	02-july	Paysandu
B	SSMA meeting with harvesting contractors	2003	02-july	Paysandu
C	Meeting in SRRN to coordinate training for locals	2003	14-july	Paysandu
C	Presentation of SSMA y FSC programe for college teachers	2003	18-august	Paysandu
C	SSMA meeting in Fray Bentos	2003	22-august	Rio Negro
C	Mafalda Tour	2003	22-august	Rio Negro
C	Open day for the community	2003	27-august	Rio Negro
C	Visit to FOSA of school Nº 23	2003	27-august	Paysandu
C	SSMA meeting in Fray Bentos	2003	28-august	Rio Negro
C	Presentation of SSMA y FSC programe	2003	03-september	Paysandu
B	Semminar - Butia Conservation	2003	10-september	Paysandu
B	SSMA meeting in Fray Bentos	2003	12-december	Rio Negro
A	Presentation of SSMA y FSC programe Finnish embassy	2003	03-october	Paysandu

Type	Participants	Year	Date	Location
C	Presentation environmental activities to school 32	2003	29-october	Rio Negro
C	Presentation environmental activities to school 34	2003	30-october	Rio Negro
C	Visit to harvesting operations of schools of Paysandú and Orgoroso	2003	03-november	Paysandu
C	Charla y Visita a Distrito Algorta con Escuela de Arroyo Negro	2003	03-december	Rio Negro
C	Seminar for Cience Club	2004	09-march	Paysandu
D	Risk prevention in Forestry conference	2004	11-May	Paysandu
B	Domestic violence semminar	2004	24-May	Rio Negro
B	Grass lands conservation workshop	2004	27-May	Rio Negro
C	Open day for the community	2004	29-May	Rio Negro
B	Safety usage of motor saw workshop	2004	29-May	Salto
D	Protected areas semminar	2004	29-july	Paysandu
C	Open meeting in guichon	2004	19-august	Paysandu
C	Biology Teachers Congress	2004	14-september	Paysandu
B	Fosa Staff party	2004	11-october	Paysandu
C	Open meeting	2004	15-october	Paysandu
B	Domestic violence semminar	2004	05-november	Rio Negro
B	Domestic violence semminar	2004	05-november	Rio Negro
C	Seminar on SGA FOSA to college in Paysandú	2005	21-May	Paysandu
B	Visit of national representative of SGA y FSC	2005	20-21- june	Rio Negro
C	Open meeting for the community	2005	24-june	Rio Negro
B	Seminar on SGA y FSC for contractors	2005	28-june	Rio Negro
B	Informative meeting on accidents statistics	2005	13-july	Paysandu
B	Informative meeting on accidents statistics	2005	13-july	Rio Negro
B	Informative meeting on accidents statistics	2005	19-july	Paysandu
B	Informative meeting on accidents statistics	2005	14-july	Paysandu
B	Informative meeting on accidents statistics	2005	14-july	Soriano
B	Informative meeting on accidents statistics	2005	14-july	Rio Negro
C	Informative meeting for the community	2005	14-july	Paysandu
B	Informative meeting on accidents statistics	2005	15-july	Rio Negro
C	Informative meeting for the community	2005	21-july	Soriano
C	Informative meeting for the community	2005	22-july	Rio Negro
C	Informative meeting for the community	2005	27-july	Paysandu
C	Visit to harvesting operations of schools	2005	27-july	Soriano
C	Visit of schools 55 y 33	2005	01-august	Soriano
C	Informative meeting for schools 55 y 34	2005	01-august	Soriano
C	Informative meeting for the community	2005	02-august	Rio Negro
B	Harvesting visit of SOFORUPA (COPAGRAN)	2005	04-august	Soriano
C	Informative meeting for the community	2005	10-august	Paysandu

Type	Participants	Year	Date	Location
C	Open day for the community	2005	10-august	Rio Negro
B	Visit "Unión de Canillitas"	2005	15-august	Rio Negro
C	Informative meeting for the community	2005	15-august	Paysandu
C	Open day for the community	2005	17-august	Paysandu
C	Presentación de FOSA a UTU Paysandú	2005	18-august	Paysandu
D	Presentation of Fauna studies in Mafalda - FOSA	2005	26-august	Rio Negro
C	Informative meeting for the community	2005	29-august	Rio Negro
C	Informative meeting for the community	2005	31-august	Rio Negro
C	Open day for the community	2005	02-september	Soriano
B	Reunión Informativa Fomento	2005	02-september	Paysandu
C	Open day for the community	2005	05-september	Rio Negro
D	Visita a cárcava de Santa Carolina - Comisión de Patrimonio	2005	06-september	Paysandu
C	Harvesting operations Visit of schools N° 47 y N° 50	2005	29-september	Soriano
B	Informative meeting for staff and contractors	2005	29-september	Rio Negro
C	Visit of the University (UE)	2005	30-september	Paysandu
C	Information meeting (SANITY)	2005	06-october	Rio Negro
C	Informative meeting for the community	2005	07-october	Paysandu
B	Staff Party	2005	10-october	Paysandu
B	Informative meeting for staff and contractors	2005	11-october	Rio Negro
C	Semminar on Biodiversity studies	2005	14-october	Paysandu
C	Informative meeting for school N° 99 - environmental care	2005	21-october	Paysandu
B	Visit of Argentinean farmers and technicians	2005	04-november	Rio Negro
C	Informative meeting for school N° 5 environmental care	2005	04-november	Paysandu

Table 4.1-2: Summary of Stakeholder Assessment Findings

Issue	Range of Perceptions and Concerns	
Plant-related jobs and activity	• Most significant source of jobs in decades for Fray Bentos • Economic activity already being felt • Uruguay's biggest foreign investment • Chain of economic activity expected throughout region	• Job opportunities may be exaggerated • Less-polluting activity could produce same benefits • Small businesses might get overlooked
Effects on tourism	• Effects on tourism uncertain or minimal • Fray Bentos's Las Cañas beach houses in demand from plant staff/contractors • Gualeguaychú may feel little impact from plants	• Tourism in region may plummet • Gualeguaychú expects loss of tourism jobs to outstrip benefits from plants • Gualeguaychú sees tourism as fundamental economic driver • Drop in tourism may undermine Gualeguaychú's entire economy, real estate
Quality of life – Environment	• Economic activity will improve quality of life	• Plants are direct threat to quality of life/values • Key concerns: Foul odors, toxic emissions (air, water), traffic, loss of bio-diversity/habitats, landscape
Quality of life - Social	• Social services – health, education etc – will improve in Fray Bentos	• Influx of construction workers may increase prostitution, venereal disease, crime, drunk driving
Eucalyptus Plantations	• Plantations extract more value from land, especially marginal lands • Creates greater chain of economic activity than other land uses	• Aggressive use of land, drains aquifers, compacts soils, increases fire dangers • Provides fewer rural jobs • Concentrates landownership • Threatens habitats • May threaten Guaraní aquifer • Requires more investment in roads
Effects on Fishing	• May have little to no impact	• May contaminate river, killing fish/making them inedible • River already strained with agrochemical runoff • Mills located in front of spawning ground • Information unclear, distances in studies incorrect • Families rely on river for subsistence

Issue	Range of Perceptions and Concerns	
Effects on Agriculture	• May have little to no impact • Honey exporters expect no impact on ability to sell abroad/prices	• May impact beef, poultry, dairy, snail, rabbit and blackberry production and exports • Honey producers in vicinity won't be able to export • Impact area may be much larger than stated
Mill sites, size	• Efficient location to take advantage of wood supply, transport • Size not unprecedented; mill complex in Brazil is bigger	• Too close to populated areas • Should consider moving to more remote location, Atlantic coast • Impacts difficult to predict because size is unprecedented
Monitoring	• Uruguay regulators said willing to shut plants if non-compliant • New national/local monitoring entities being created • Governments ask United Nations for assistance	• Uruguay lacks technical capacity • Political and economic pressures will reduce effectiveness • May lack consistency over mills' lifetime • Bi-national entity should monitor
Technology	• Mills will comply with European regulations as of 2007	• Mills won't comply with European regulations as of 2007
Transportation/ Chemicals	• Fray Bentos creating new emergency response teams	• Increased risk of road accidents • Increased risk of chemical spills • Fray Bentos lacks resources to respond to chemical/industrial emergency • Chemical suppliers create new risks
Views on public engagement to review mills' impacts	• Engagement/dialogue must have pre-defined set of topics • Must not be used to stage protests • Must be a safe space for civil dialogue • Meetings open to general public are often unproductive	• Must be accountable and transparent, with clear rules of engagement • Must first receive a sign that concerns will be acknowledged and responded to • Process can't be rushed • Meetings should strike balance between being open to public, and being a manageable size

Issue	Range of Perceptions and Concerns	
Views on convening dialogue	• IFC could convene process, hire neutral facilitator	• Stakeholders should identify a mutually credible convener • Some initial suggestions: CAO office, Bi-National Technical Commission, Key public officials
Views on quality of current information	• Companies have provided extensive amounts of credible information • Uruguay regulators have shared comprehensive information with Argentina • IFC is committed to reviewing scientific material from stakeholders	• Basic data such as distances incorrect in company reports, calling into question all information • Uruguay regulators haven't shared enough detail with Argentina • Stakeholders lack clear language to understand impacts • Cumulative Impact Study questioned because of comments from initial lead writer • Opponents want an opportunity to present their scientific studies • A panel of experts could provide a mutually credible source of information • Experiences from communities with functioning mills should be considered

Table 4.1-3: Physical Characteristics of Effluent Discharge for Botnia and ENCE

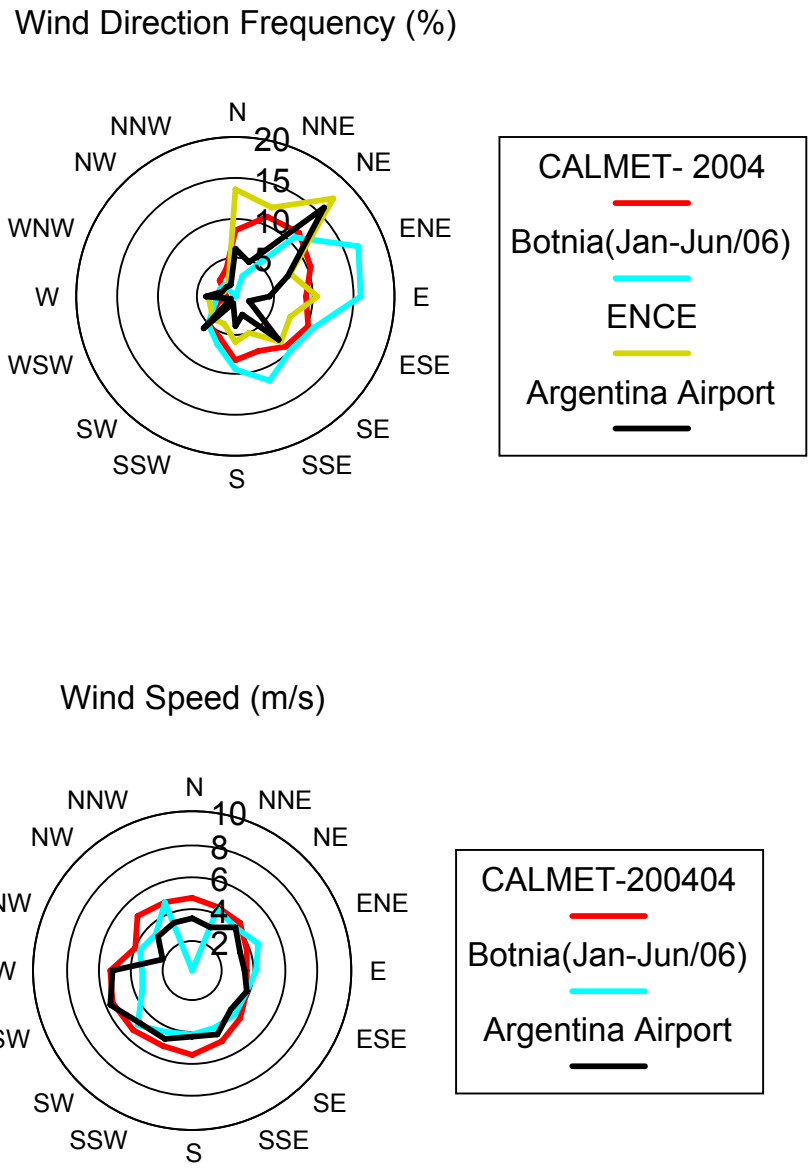
Characteristic	Botnia	ENCE
Length of outfall pipe	200 m	200 m
Diffuser length	200 m	200 m (original) 100 m (recommended)
Orientation of diffuser	90° to ambient flow	90° to ambient flow
Number of nozzles	80	80 (original) 40 (recommended)
Nozzle diameter	0.1 m	0.1 m
Nozzle vertical orientation	90° (original) 0° (recommended)	0°
Nozzle horizontal orientation	0° to ambient flow	0° to ambient flow
Average water depth	13.5 m	19.5 m

Table 4.1-4: Effluent Characteristics for the Botnia and ENCE Discharges

Parameter	Units	Expected Operating Levels*			
		Botnia		ENCE	
		Annual Average	Monthly Maximum	Annual Average	Monthly Maximum
Aesthetic					
Floating material		absent	absent	absent	Absent
Color	kg/ADt	9	10	6.4	11
Conventional					
Temperature	°C	28	30	<30	30
TSS	kg/ADt	0.7	1.3	0.9	1.6
pH		7.5	6.0 to 9.0	6.0 to 9.0	6.0 to 9.0
Conductivity	µS/cm	<5000	5000	<4000	4000
COD	kg/ADt	8	15	8.7	19
BOD	kg/ADt	0.3	0.7	0.6	1.3
AOX	kg/ADt	0.08	0.15	0.10	0.22
Oil and grease		negligible	0.31	negligible	0.35
Detergents		negligible	0.025	negligible	0.09
Microbiological					
Fecal coliforms	/100mL	negligible	negligible	negligible	negligible
Nutrients					
N total	kg/ADt	0.15	0.26	0.17	0.30
Nitrates (NO_3)	kg/ADt	0.08	0.13	0.09	0.14
Ammonia **(free)**	kg/ADt	0.016	0.026	0.020	0.030
Total Phosphorus	kg/ADt	0.012	0.03	0.017	0.035
Toxins					
Chlorophenols	kg/ADt	0.00175	0.00263	0.0015	0.0024
Cyanide	kg/ADt	negligible	0.00625	<0.0003	0.006
Phenolic compounds	kg/ADt	0.000055	0.0000055	0.000029	0.000046
Plant sterols	kg/ADt	0.004	0.006	0.005	0.0075
Resin/fatty acids		negligible	negligible	0.0006	0.0006
Sulphides	kg/ADt	0.006	0.006	0.005	0.005
Dioxins/furans	kg/ADt	<2.5E-10	-	<2.9E-10	-
Metals					
Arsenic	kg/ADt	0.002	0.003	0.0003	0.015
Cadmium	kg/ADt	0.0002	0.0003	0.00009	0.0015
Copper	kg/ADt	0.004	0.006	0.000003	0.03
Chromium	kg/ADt	0.004	0.006	0.0009	0.03
Mercury	kg/ADt	<0.000125	-	-	-
Nickel	kg/ADt	0.008	0.013	0.0021	0.06
Lead	kg/ADt	0.0013	0.0019	0.0003	0.009
Zinc	kg/ADt	0.0011	0.0017	0.00009	0.009

* Expected production is 1,000,000 ADt/year for Botnia and 500,000 ADt/year for ENCE.

Figure 4.1-1: Wind Rose for Available Meteorological Data and Model Prediction



4.2 Plantations

In December, 1987, the Uruguayan Congress approved law number 15,939 which promoted the development of new tree planting programs with support from donor countries through international financial agencies (such as the World Bank) and through government tax and subsidy programs. Regulations under the law were promulgated by the Dirección General Forestal (Uruguayan Forest Service) which is a branch of the Ministry of Animal Husbandry, Agriculture, and Fisheries.

Applications for new plantations are sent to the forestry service which reviews the proposals against a number of criteria. One of most essential of these is the soil classes within the proposed site. Only those soils classified by CONEAT (Commission Nacional de Estudio Agroeconomico de la Terra) as having a priority for tree plantations could be utilized for the conversion of land to plantations. This criterion seeks to have ensured that soils with a high capability for cultivation under row crops or high quality pasture were not converted to other uses. Generally, this resulted in the conversion of less productive lands that had predominantly been used as low-productivity pasture for cattle and sheep grazing.

At one time, many of these lands were natural grasslands and shrublands that had been converted to grazing lands through burning during a time referred to as the “Merino Period” (after the Merino Sheep). Thus, the soils of such areas had already been impacted by compaction and the natural vegetation had been largely extirpated prior to their conversion to forestry plantations.

As these plantations have developed, both round wood (whole logs) and wood chips have been exported to international markets. Uruguay is now encouraging the development of further value-added processing of these forest products and the two pulp mills intended for development in the Fray Bentos area are part of this development of the country’s industrial base.

The environmental impacts of plantation development have been addressed in the individual impact assessments prepared for these investments, in Annex B of this CIS report, and through the sustainable forest management certification process. These include potential social and environmental impacts associated with changes in land use and the ongoing operation of eucalyptus plantations. In all cases, these impacts have been found to be low to medium, and can be mitigated.

Both Botnia and ENCE, have plantation companies (Forestal Oriental, or FOSA, and EUFORES, respectively) with significant plantation holdings. Both companies also purchase wood from other third-party plantation companies, under short or long-term contracts. It is important to note that these plantations (assuming maturity) are currently producing round wood and chips for export. With the development of these mills, this wood will instead be directed to domestic pulp production. More detailed consideration of the plantation situation is presented in Annex B of this report.

Potential cumulative impacts of the two mills with regard to plantation development and operation are described below.

4.2.1 Conversion of Additional Land to Plantations

During full production, 208,000 ha of eucalyptus plantations will be required to supply the mills (conservatively based on an eight year rotation and 25m^3/ha/yr productivity). This breaks down to about 140,000 ha for Botnia and 68,000 ha for ENCE, although if the actual productivity being achieved at Botnia's plantations is maintained it will reduce their requirements to about 125,000 ha or less. Production at the mills will ramp up over time and thus be lower in the first years of operation. This should reduce the required supply during the first rotation period to approximately 175,000 ha.

As of mid-2006, the combined land holdings of the two companies within the Littoral Region amounts to about 120,000 ha planted in eucalyptus. This accounts for at least 70% of the wood supply required by both mills within the first eight years of operation. Conservatively estimated there is another 20,000 ha of plantations under third party ownership within the Littoral Region (based on the 2003 inventory prepared by the Dirección General Forestal). This number likely underestimates the amount of plantations owned and operated by third parties as additional plantations have been added since 2003. The companies have indicated that there are also 87,000 ha available to them from the departments of Tacuarembó, Durazno, and Florida which are within an economically viable distance from Fray Bentos. Not all third party contracts have been secured at this time, however the total existing plantation area owned by, and potentially available to, the companies exceeds the area required to supply both mills at full production. In addition, the companies own 40,000 ha in the Littoral Region that was not planted as of mid-2006 but is available for planting. Once planted, company direct land holdings will equal 77% of the full production requirements.

In these six departments of Uruguay, approximately 1,500,000 ha of land have been designated as "Forest Priority Soils", on which forest plantations are encouraged. As shown in Table 4.2-1, the total area planted to eucalyptus as of the end of 2003 amounts to about 17% of the priority soils potentially available. Table 4.2-1 also shows that more than sufficient land area had been planted to eucalyptus by the end of 2003 to supply the two mills through start-up and in full production. Although all of this wood may not be available due to other commitments, additional areas of eucalyptus plantations have been developed in these departments over the almost three years since the end of the reporting period. The companies also anticipate that another 30,000 to 40,000 ha/yr will be planted within an economical distance from the mills over the next 3 years. Although some of this wood may be available to cover short-term shortfalls, it will be utilized principally for saw logs and export.

Table 4.2-1: Eucalyptus Plantation Land Use Characteristics in Western and Central-North Uruguay (in ha unless otherwise noted)

1. Total land area – 6 departments	6,865,500
2. Total area of forest priority soils	1,516,760
3. Total net planted area, eucalyptus (approx. as of 2003)	260,000
% of land area already planted (3÷1)	3.7
% of forest priority soils planted (end of 2003) (3÷2)	17.1
4. Total area needed during start-up 8 years	175,000
% of already planted area required for start-up (4÷3)	67.3
5. Planted area required by mills after start-up	208,000
% of already planted area required after start-up (5÷3)	80.0

4.2.2 Plantation Development by Other Third Parties

As noted above, both Botnia and ENCE anticipate a reliable supply of pulpwood from their own plantations and from existing plantations owned by third party suppliers. It is unlikely that a large number of independent land owners would make a long-term investment in plantation development in this area in the future hope of supplying the mills when both Orion and CMB have their own reliable supply.

It is possible that future plantations may be developed to supply other wood products industries (sawmills, furniture manufacturers, panel producers) or industries seeking sources of local energy, but there are no incentive programs at present to promote this nor are there any known plans for such operations. However, should they proceed, it would not be the result of the pulp mills and, hence, would not be a cumulative impact of the presence of the two mills. Botnia has developed plantations specifically for the mill and therefore will not impact established wood supplies. Likewise, ENCE has also developed its plantations to supply the mill and will use its existing and third party plantations in other parts of Uruguay to serve its existing export market of wood chips.

It is therefore unlikely that the establishment of the pulp mills will encourage significant development of plantations by other third parties, and this potential cumulative impact is not considered significant.

4.2.3 Additional Plantation Development in Other Areas of Uruguay

Transportation costs are the main controlling factor in wood supply, and it is generally not competitive to source wood from greater than about 150 to 200 km from the mills. There

may indeed be wood available beyond the six departments noted in Section 4.2.1, especially thinnings from plantations operated to produce larger round wood, but it is less likely that these would be competitively priced, and very unlikely that landowners in those regions would establish new plantations with the intention of supplying the new pulp mills, especially when those mills are already planting areas nearby to supply their own wood.

It is therefore not likely that these pulp mills will encourage additional planting in other regions of Uruguay, and this potential cumulative impact is not considered to be significant.

4.2.4 Plantation Development in Natural Forests

Uruguayan law prohibits the removal of natural forests or impacts to formally designated protected areas. It was noted above that it is unlikely that the mills will induce much further planting, thus there should not be any additional pressure on natural forests as a result because plantation-derived wood supplies are adequate to meet current and future needs. Secondly, forestry plantation development is restricted under law to areas already designated as “Forest Priority Soils” which excludes areas of natural forest. Thirdly, the additional planting area available within company-owned lands will be certified according to FSC standards, which prohibit the development of plantations in natural forests, and in fact requires the delineation of protected areas of natural forest as part of the plantation area.

It is therefore not likely that the pulp mills will encourage development of plantations in areas currently under natural forest cover, thus any potential cumulative impact is not considered to be significant.

4.2.5 Land Ownership

There is no evidence to suggest that plantation development will adversely impact small landholders within the region where Botnia and ENCE have their plantations. Most of the companies’ plantations were purchased from absentee landlords in a willing seller-willing buyer relationship, at prevailing market rates. The companies report that they can be very selective in their land purchases, as they have had numerous offers of land for purchase. No lands are purchased from unwilling sellers. Also, recent evidence shows that employment on the plantations is greater than in the declining cattle-raising economy, in this area. For example, many large-scale plantations, including those of FOSA and EUFORES operate agroforestry operations whereby agriculture activities such as grazing, apiaries, mushroom collection etc. may be conducted along with forestry. Additional jobs are also created in those plantations which incorporate protected areas and in which ecological restoration programs are conducted.

It is therefore unlikely that the pulp mills will play any role in driving smallholders off their lands on an involuntary basis, and this potential cumulative impact is not considered to be significant.

4.2.6 Soil and Water Management

Soil compaction and erosion are often cited as serious environmental impacts resulting from plantation forestry. In general, compaction impacts are highly localized (i.e., roads and handling areas) and erosion losses will be limited by the acknowledged reduction in surface runoff from plantations. Further, the sites are harvested every eight to nine years, reducing soil erosion and compaction impacts compared to agricultural areas under an annual harvesting regime. In the case of lands managed for the Botnia and ENCE mills, most are established on flat to gently rolling lands further reducing the potential for soil erosion and the loss of soil nutrients. These lands also occur in areas having an annual water deficiency of some 50 mm/year, reducing infiltration, mineral leaching, and runoff.

Based on existing information, the most serious potential impacts of the existing and planned plantations relate to water management issues – both surface water and groundwater. Surface water runoff from large plantations is known to be up to 25% less than from similar areas of grassland and grazing lands [6]. This is due, in large part to the greater take-up and evapotranspiration by trees compared to grasslands. A significant volume of this water is returned to the atmosphere and is thus available for the hydrological cycle.

Eucalyptus plantations are known to be heavy users of groundwater, although the actual impact from individual trees is likely quite minimal because they are relatively shallow rooted. The exact impacts on groundwater are not well documented, however, there are several studies currently underway in Uruguay.[7] Potential impacts to particularly significant groundwater resources, such as those associated with the Guarani aquifer western Uruguay need to be more fully evaluated.

In general, cumulative impacts to soils from eucalyptus plantations are not considered significant, especially as they will be mitigated by silvicultural techniques required to maintain productivity in the planted forest. Water management issues are more uncertain and should receive greater attention.

It is recommended that the forestry companies supplying the two mills continue their participation in the on-going Uruguayan State University studies pertaining to impacts on soils, surface water, and groundwater.

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[6] Geary, Thomas F. “Afforestation in Uruguay: Study of a Changing Landscape,” Journal of Forestry 99, no.7 (July 1, 2001): 35-39

[7] Forest Management Certification Report, SGS Qualifor (July 31, 2003) p.29, http://64.233.187.104/search?q=cache:AkEBk0Bd0bsJ:www.qualifor.sgs.com/8365-uy-fm-eufores_ma2004.10_ad65-01_final-psummary__2_.pdf+%22Forest+Management+Certification+Report%22+Uruguay+SGS+Qualifor+&hl=en

4.3 Biodiversity and Natural Habitats

Biodiversity encompasses the range of species (flora and fauna), of species' gene pools, and of landscape patterns. It can include both exotic and endemic species but healthy ecosystems are generally measured by having few or no exotic species. Eucalyptus plantations clearly consist of exotic species of trees, although some species of eucalyptus have been present in South America for over 200 years. Thus, in evaluating cumulative impacts on biodiversity due to the development of eucalyptus plantations, one must determine the nature of the impact in terms of changes from pre-existing species (and gene pools and landscape patterns) in terms of both exotic and endemic relationships.

As noted in Section 4.2 of this report, the Uruguayan forest service evaluates plantation development applications on the basis of soil capability, such that highly productive soils most suitable to intense cultivation are not being converted. Also, Uruguayan law prohibits the removal of natural forests or impacts to formally designated protected areas. As a result, the vast majority of lands converted to forest plantations have been converted from marginally productive areas, formally supporting mostly sheep and cattle grazing. Such areas may contain a greater diversity of individual species and gene pools than occur within the planted portion of eucalyptus plantations, but both areas largely contain exotic species.

Geary (2001) points out that impacts on biodiversity of the natural ecosystem as result of eucalyptus plantations are hard to specify, as the grasslands in Uruguay have been modified by human actions (such as livestock grazing) for hundreds of years:

> "Because of the small percentage of the land area in Uruguay to be converted to tree plantations, a significant impact on biodiversity might seem unlikely. Moreover, the effect on natural biodiversity could be hard to interpret as biodiversity has been modified by centuries of pastoral and agricultural uses. Exotic grasses and other exotic pastoral plants are often the common vegetation. Erosion probably has irreversibly changed the ecosystem."[8]

Many large plantations in Uruguay, including those owned by EUFORES and FOSA, are managed under an agroforestry regime which often incorporates natural areas within a mix of land uses. Only about 65% or so of these plantations are directly planted to eucalyptus with remaining areas used for cattle grazing (including on areas used as fire-breaks) and other agricultural activities. EUFORES has reported that under their Forest Stewardship Council (FSC) certification, they ensure sensitive areas, including areas formally designated at regional and national levels as High Value Conservation Areas (HVCA), are protected. As part of an initial impact assessment, the company defines management plans for such areas that include, natural areas (grasslands, wetlands, palm groves, natural forests,

[8] Geary, Thomas F. "Afforestation in Uruguay: Study of a Changing Landscape," Journal of Forestry 99, no.7 (July 1, 2001): 35-39

stream corridors, etc.) which have a high biodiversity.[9] Similarly, they include forests and woodlands that provide important water resource protection functions; areas defined under international agreement (Ramsar Convention on Wetlands, Convention on Migratory Species, Convention on Biological Diversity and so on); and areas of traditional cultural interest.

Monitoring programs conducted by EUFORES in wetlands and palm groves over a 10-year period in their Santo Domingo operation (Department of Paysandú) have documented a wide list of species as well as the return of several formerly extirpated species as a result of wetland restoration programs.[10] They have documented at least 242 species including 13 amphibians, 17 reptiles, 191 birds, and 23 mammals in this area.

FOSA also prepare management plans for natural areas contained within their plantation properties. These include a variety of ecosystems such as natural forests, wetlands and designated protected areas[11]. Management plans include the documentation of native species and the development of monitoring plans. The management plans require the maintenance of natural biodiversity and ecological functions of each area. Ecological monitoring in these areas includes documentation of any changes in vegetation, birds, and rare or threatened flora and fauna.

Although the direct replacement of grazing land for planted trees may result in a decrease in the biodiversity of exotic species, the operation of large multi-use forestry plantations containing other agricultural activities along with the inclusion of natural areas, clearly results in an increase in biodiversity at all levels (species, gene pools, and landscape patterns) including both exotic and endemic species.

As a result, cumulative impacts to biodiversity as the result of the conversion of grazing lands to forestry plantations are not considered to be significant.

4.4 Air Quality Impacts

The potential effects of the air emissions from the Botnia and ENCE mills are described in the sections below. The discussion addresses specific receptor locations of interest as listed in Section 4.1.3.1. Further details are provided in Annex C, Section C5.

The assessment references air quality and air quality standards based on averaging times (e.g., 1-hour, 24-hour or annual). The length of time that a person, or some part of the environment, is exposed to pollutants is important because impacts occur from different

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[9] Bentancor, A. and Delgado, S. Caracterización de los Bosques Nativos de los Establecimientos Propiedad de EUFORES S.A. EUFORES S.A., July 2005.

[10] EUFORES S.A. Informe Final Relevamiento de la Diversidad de Vertebrados Tetrapodos Establecimientos Forestales EUFORES Uruguay. Unpublished Report, EUFORES.

[11] SGS Qualifor. Evaluation of Forest Management Operations. Qualifor Program, No. AD 65, Projects 6609-UY, April 2000.

types of exposure. A long exposure, like an annual average concentration, is important when assessing the long term health risk on people. A daily exposure (24 hour average concentration) has been used to characterize short term health and material impacts, whereas short term exposure (1-hour average concentration) can have both immediate health and material impacts. Odour is somewhat unique in that most people can sense and identify an odour within seconds and therefore standards are often set based on a 10-minute average concentration as well as longer durations. Odours can also have varying thresholds of detection depending upon the ambient air quality and the degree of sensitivity of the person.

It should also be noted that winds don't blow in exactly the same direction for very long, and as a result, ambient air quality tends to be highly variable. This variability is accounted for by averaging the predicted air quality over the duration of exposure (1-hour, 24-hour and annual), and by considering the worst air quality that occurs over the averaging period and over the one-year simulation. The 1-hour concentrations referred to below therefore represents the highest concentration predicted during the one-year simulation, and the annual average concentrations represent the average for the year.

For normal operating conditions where the emissions are relatively constant, variability is dependant on meteorological conditions only. However, for upset conditions, variability is also dependant upon the occurrence of the upset event relative to the meteorological condition. The analysis presented below conservatively assumes that the upset conditions is concurrent with the worst case meteorological condition (i.e., the condition causing poor air dispersion).

4.4.1 Air Receptor 1, the Areas Adjacent to the Mill Properties

The area adjacent to the mill properties where the maximum calculated ground based concentration occurs is identified as a sensitive receptor. It represents the receptor having the absolute worst case impact. Under most conditions, the location of the maximum concentration is just west of the ENCE mill within a predominantly forested area. However, at times the maximum concentration is located just east of the Botnia mill within their property boundary and within an area of mixed forest.

The maximum concentration will remain in compliance with all respective air quality criteria under all operating conditions. The concentration of SO_2 is predicted to change on an annual average basis by 0.2 µg/m^3. In comparison, the typical ambient concentration of SO_2 is approximately 13 µg/m^3 with a range of 5 to 30 µg/m^3. Likewise the incremental annual change of NO_2 and particulate matter (PM_{10} and $PM_{2.5}$) are predicted to be 0.5, 0.1 and less than 0.1 µg/m^3, respectively, which are significantly lower than typical ambient concentrations of 15, 20 and 8 µg/m^3, respectively. These incremental changes will not be measurable.

The typical ambient air quality concentrations, used as reference points in this document, are based on monitoring in the rural United States as published by the US EPA (1997).

These typical ambient concentrations were used since ambient air quality data were not available for Uruguay or Argentina within the general area of the two mills.

Under normal operating conditions, the 1-hour concentration of SO_2 and NO_2 are predicted to change by 22 and 61 µg/m^3, respectively, which are significantly lower than the respective air quality criteria of 690 and 200 µg/m^3. The 1-hour concentrations for particulate matter (PM_{10} and $PM_{2.5}$), VOCs and chlorine compounds are also significantly below the ambient air quality criteria.

During upset conditions, the 1-hour concentration of SO_2 and NO_2 are predicted to change by 141 and 90 µg/m^3, respectively, which are also significantly lower than the respective air quality criteria. Likewise, the 1-hour concentrations of TRS and particulate matter are well within the criteria. This prediction is based on the conservative and perhaps extremely unlikely assumption that the upset condition occurs simultaneously at both facilities and during periods of poor air dispersion).

Since the predicted concentrations of SO_2, NO_2 and particulate matter are all below their respective air quality criteria, it is concluded that there is no potential for health effects arising from air emissions due to mill operations at this receptor.

Odour will not likely be detectable under normal operating conditions on or immediately adjacent to the mill properties, although it may be detected under upset conditions. Fewer than ten detection events are expected per year based on operating experience at other modern mills, and only a few of these may be considered objectionable by someone with a sensitive sense of smell. The detection of odour does not represent a health concern since the 24-concentration of TRS is well below the WHO criteria, although, people on or near the site may notice a sewer type smell or, on occasion, a stronger unpleasant smell. During the first year of operation, it is possible that the NCG system may vent to the atmosphere on occasion for minutes to possibly hours at a time until the collection system is fully functional, after which venting will be limited to a few seconds to minutes in duration.

4.4.2 Air Receptor 2, the City of Fray Bentos

The city of Fray Bentos (population 22,600) is the closest community to the two mills and is located approximately 5 km west of the Botnia mill and approximately 11 km west of the ENCE mill. It is also the community which will receive the highest incremental change in air quality resulting from emissions from the two mills, although as discussed below, these changes will not adversely affect human health or aesthetic environment of the community.

The annual average concentrations of SO_2 and NO_2 are predicted to change by 0.1 and 0.3 µg/m^3, respectively, in comparison to the reference ambient concentration of 13 and 15 µg/m^3 for rural United States. The annual average concentrations of particulate matter are also well below the typical ambient concentrations. These incremental changes will not be measurable.

Under normal operational conditions, the 1-hour concentrations of SO_2 and NO_2 are predicted to change by 8 and 19 µg/m^3, respectively. These values are significantly lower (88 and 11 times) than the standard indicating that there will be no potential for health effects. Likewise, the 1-hour concentrations for particulate matter, VOCs and chlorine compounds are also significantly below the ambient air quality criteria, and therefore will not cause health effects.

During upset conditions, the 1-hour concentration of SO_2 and NO_2 are predicted to be 62 and 24 µg/m^3, respectively, which are also significantly lower (11 and 8 times) than the standard. Likewise, the 1-hour concentrations of TRS and particulate matter are well below the health criteria. These predictions assume that an upset occurred at both facilities at the same time and during worst case meteorological conditions, which collectively are extremely unlikely to occur.

Since the predicted concentrations of the identified parameters are all below their respective air quality criteria, it is concluded that there is no potential for health effects arising from air emissions due to mill operations within the city of Fray Bentos.

Odour will not be detectable within the city of Fray Bentos under normal operating conditions, but detection is possible during upset conditions. Fewer than ten detection events are expected per year based on operating experience at other modern mills, and only a few of these may be considered objectionable by someone with a sensitive sense of smell. As previously discussed, the duration of such events may range from a few minutes to a few hours during the first year of operation, and reduced to a few seconds to minutes thereafter. The detection of odour may range from a sewer type smell which may or may not be attributable to the mill, to a stronger odour that would be readily attributed to the mill.

4.4.3 Air Receptor 3, the City of Mercedes

The city of Mercedes (population 45,000) is located inland from the Rio Uruguay along the Rio Negro towards the south east located approximately 25 km from the Botnia mill and approximately 20 km from the ENCE mill. The incremental change in air quality at the city of Mercedes is predicted to be lower than the incremental change at the city of Fray Bentos, and therefore it is concluded that these changes will not adversely affect human health or aesthetic environment of that community.

The change in air quality for all parameters is predicted to be far below the respective ambient air quality criteria, indicating no potential for human health effects. The concentrations of SO_2 and NO_2 are predicted to change by less than 0.1 µg/m^3 on an annual average basis and by less than 1 µg/m^3 on a 24-hour basis. These low changes in concentration are well below ambient air quality standards and well below the reference ambient air quality for rural United States. Likewise the incremental change of TRS, particulate matter, VOC and chlorine compounds are also very low. These incremental changes will not be measurable.

The odour effect level is also predicted to be lower than the detection threshold under both normal and upset conditions. This change will be imperceptible to the residents of Mercedes.

4.4.4 Air Receptor 4, the City of Nuevo Berlin

The city of Nuevo Berlin is located along the shores of Rio Uruguay, north east of the two mills a distance of approximately 20 km. The city is located towards the southern end of the wetland areas of Esteros de Farrepos e Islas del Rio Uruguay, which is Uruguay's second designated Ramsar site because of the diversity of plant and wildlife species that it supports. The air quality predictions for the city of Nuevo Berlin provide a conservative estimate of the air quality over the wetland region.

The predicted incremental change in air quality at the city of Nuevo Berlin is comparable to the incremental change at the city of Mercedes, and therefore the same conclusion of no effect applies. The change in air quality, for all parameters is predicted to be far below the respective ambient air quality criteria, indicating no potential for human health effects or odour related effects.

The concentrations of SO_2 and NO_2 are predicted to change by less than 0.1 µg/m^3 on an annual average basis and by 0.5 to 1.2 µg/m^3 based on as 24-hour average. These low changes in concentration are well below ambient air quality standards and well below the reference ambient air quality for rural United States. Likewise the incremental change of TRS, particulate matter, VOC and chlorine compounds are also very low. These incremental changes will not be measurable. Since the incremental change in ambient air quality is not measurable, there should be no adverse effects to the wetland area of Esteros de Farrapos e Islas del Rio Uruguay.

Odour will not be detectable within the city of Nuevo Berlin during both normal operating and upset conditions.

4.4.5 Air Receptor 5, the Beach Resort of Las Cañas

Las Cañas is a beach resort located along the shores of the Rio Uruguay approximately 12 km from Botnia, and 17 km from ENCE, towards the south west of the two mills. The beach attracts visitors from throughout Uruguay and Argentina, and is therefore an important resource for local tourism.

The 24-hour concentration of SO_2, NO_2, PM_{10} and $PM_{2.5}$ are predicted to be 1.1, 2.6, 0.5 and 0.4 µg/m^3, which are significantly lower than the reference ambient air concentrations of 13, 15, 20 and 8 µg/m^3, respectively. These incremental changes will not be measurable. Furthermore, the concentration of all air quality parameters are predicted to be significantly lower than the ambient air quality criteria under both normal and upset operating conditions, and therefore no adverse effects to human health are expected as a result of the combined air emissions from the two mills.

Odour will not be detectable at Las Cañas under normal operating conditions, but during upset conditions and times of poor air dispersion, the odour effect level is predicted to be above the detection threshold for a person with a sensitive sense of smell. This means that during an upset someone in Las Cañas may detect an odour similar to that experienced in daily life (such as garbage, a poorly tuned car, a sewer) but may not be able to characterize its source. This occurrence is most likely during pre-dawn when air dispersion is poor, and may occur up to ten times per year based on operational experience at modern mills.

4.4.6 Air Receptor 6, the Beach Area of Playa Ubici

Playa Ubici is a recreational beach area located across Yaguareté Bay from the Botnia mill. The beach is a valuable resource for the city of Fray Bentos and for tourists who may visit the area. It is used for camping, swimming and other outdoor recreational activities.

The incremental change in air quality at the beach area is predicted to be comparable to that for the city of Fray Bentos. It is concluded that these changes will not adversely affect human health or the aesthetic environment of the beach and camping areas.

Odour will not be detectable at Playa Ubici under normal operating conditions, but detection is possible during upset and worst case meteorological conditions. The odour effect level is predicted to be below the level which may be considered objectionable by someone with a sensitive sense of smell. Detection of odour may occur up to ten times per year based on operational experience at modern mills and is most likely to occur at night when air dispersion is poor.

4.4.7 Air Receptor 7, the International Bridge

The International Bridge provides the nearest road access connecting Uruguay and Argentina. The change in air quality at the International Bridge is also predicted to be comparable to that at Fray Bentos, and therefore also concluded that human health and aesthetic environment are protected. It is predicted that the odour will not be detectable during normal operating conditions but detection is possible during upset and times of poor air dispersion. Detection of odour may occur up to 10 times per year and most likely at night when air dispersion is poor.

4.4.8 Air Receptor 8, the City of Gualeguaychú, Argentina

The city of Gualeguaychú, Argentina (population 76,220) is the nearest community in Argentina to the mills. It is located approximately 25 km towards the north west of the Botnia mill. The city is a thriving community located in the province of Entre Ríos, Argentina, on the bank of the Rio Gualeguaychú, a tributary of the Rio Uruguay. The city hosts an annual Carnival that is regionally well-known and attended by people from across Argentina and Uruguay.

The predicted change in air quality at the city of Gualeguaychú, for all parameters, is predicted to be far below the respective ambient air quality criteria, indicating no potential for human health effects or odour related effects, or impact on the aesthetic environment of the community.

The concentrations of SO_2 and NO_2 are predicted to change by less than 0.1 µg/m^3 on an annual average basis and by 0.5 to 1.2 µg/m^3 based on as 24-hour average. These low changes in concentration are well below ambient air quality standards and well below the reference ambient air quality for rural United States. Likewise the incremental change of TRS, particulate matter, VOC and chlorine compounds are also very low. These incremental changes will not be measurable.

The odour effect level is predicted to be lower than the detection threshold under both normal and upset conditions. This change will be imperceptible to the residents of Gualeguaychú.

4.4.9 Air Receptor 9, the Beach Area at Ñandubaysal, Argentina

A beach and camping ground is located at Ñandubaysal in Argentina across the Rio Uruguay from Fray Bentos. The site is a popular vacation and tourist destination for people from Argentina and Uruguay during the summer months and particularly during the annual Carnival. It is located approximately 13 km from Botnia, and 19 km from ENCE, towards the north west of the two mills.

The 24-hour concentration of SO_2, NO_2, PM_{10} and $PM_{2.5}$ are predicted to be 0.9, 2.2, 0.5 and 0.3 µg/m^3, which are significantly lower than the reference ambient air concentrations of 13, 15, 20 and 8 µg/m^3, respectively. These incremental changes will neither be measurable nor perceptible. Furthermore, the concentration of all air quality parameters are predicted to be significantly lower than the ambient air quality criteria under both normal and upset operating conditions, and therefore no adverse effects to human health are expected as a result of the combined air emissions from the two mills.

Odour will not be detectable at Ñandubaysal under normal operating conditions, but during upset conditions and times of poor air dispersion the odour effect level is predicted to be above the detection threshold for a person with a sensitive sense of smell. This means that on occasion and for a short period of time, someone at Ñandubaysal may detect an odour similar to that experienced in daily life (such as garbage, a poorly tuned car, a sewer) but may not be able to characterize its source. This occurrence is most likely during pre-dawn when air dispersion is poor, and may occur up to ten times per year based on operational experience at modern mills. The duration of the odour event is expected to range from a few seconds to minutes following the first year of operation.

The Botnia mill is slightly visible from the beach area at Ñandubaysal, although the mill and its stack blend into the landscape of Fray Bentos. During cold humid weather, a white vapour plume may be visible extending from the stack.

4.4.10 Air Receptor 10, Beyond the International Bridge, Argentina

Receptor 10 is located along the highway and inland from the International Bridge on the Argentine side of the Rio Uruguay approximately 6 km from the Botnia mill and 9 km from the ENCE mill. It is considered the most sensitive receptor within Argentina due to its close proximity to the two mills.

The annual average concentrations of SO_2 and NO_2 are predicted to change by 0.1 and 0.3 µg/m^3, respectively, in comparison to the reference ambient concentration of 13 and 15 µg/m^3. The annual average concentrations of particulate matter are also well below the reference ambient concentrations. These incremental changes will not be measurable.

Under normal operational conditions, the 1-hour concentrations of SO_2 and NO_2 are predicted to change by 3 and 12 µg/m^3, respectively. These values are significantly lower (230 and 17 times) than the standard indicating that there will be no potential for health effects. Likewise, the 1-hour concentrations for particulate matter, VOCs and chlorine compounds are also significantly below the ambient air quality criteria, and therefore will not cause health effects.

During upset conditions, the 1-hour concentration of SO_2 and NO_2 are predicted to be 42 and 16 µg/m^3, respectively, which are also significantly lower (16 and 12 times) than the standard. Likewise, the 1-hour concentrations of TRS and particulate matter are well below the health criteria. These predictions assume that an upset occurred at both facilities at the same time and during worst case meteorological conditions, which collectively are extremely unlikely to occur.

Since the predicted concentrations of the identified parameters are all below their respective air quality criteria, it is concluded that there is no potential for health effects arising from air emissions due to mill operations within Argentina.

Odour will not be detectable at this receptor under normal operating conditions, but detection is possible during upset conditions. Fewer than ten detection events are expected per year based on operating experience at other modern mills, and only a few of these may be considered objectionable by someone with a sensitive sense of smell. The duration of such events may range from a few minutes to a few hours during the first year of operation, and reduced to a few seconds to minutes thereafter. The detection of odour may range from a sewer type smell which may or may not be attributable to the mill, to a stronger odour that would be readily attributed to the mill.

Odour will not be detectable within the city of Fray Bentos under normal operating conditions, but detection is possible during upset conditions. Fewer than ten detection events are expected per year based on operating experience at other modern mills, and only a few of these may be considered objectionable by someone with a sensitive sense of smell. As previously discussed, the duration of such events may range from a few minutes to a few hours during the first year of operation, and reduced to a few seconds to minutes

thereafter. The detection of odour may range from a sewer type smell which may or may not be attributable to the mill, to a stronger odour that would be readily attributed to the mill.

4.4.11 Summary of Potential Effects on Ambient Air Quality

Table 4.4-1 provides a summary of the potential effects of mill operations on the ambient air quality. As presented, the air quality remains in compliance with ambient air quality criteria under all meteorological conditions and operating conditions at all receptor locations. It is therefore concluded that there is no potential for human health effects associated with mill emissions. However, it is possible that odour may be detected on occasion (less than 10 times per year) within the areas adjacent to each mill and possibly within the city of Fray Bentos and at the international bridge.

Table 4.4-1: Summary of Potential Effects of Air Emissions

Receptor 1	**Area on or adjacent to the mill properties**
Combustion Products (NO_2, SO_2, PM, PM_{10}, $PM_{2.5}$)	• Greatest potential change in ground based ambient air quality. Air quality remains in compliance with ambient air quality criteria under all meteorological conditions and operating conditions, therefore limited potential for human health effects.
Reduced Sulphur Compounds (Odour)	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
Volatile Organic Compounds	• Predicted ambient air concentration far below ambient air quality criteria, and therefore, emissions of VOCs from the mills are not anticipated to have a significant effect on the environment.
Chlorine and Chlorine Dioxide	• Predicted ambient air concentration is far below ambient air quality criteria, and therefore emissions from the chlorine plant are not anticipated to have a significant effect on the environment.
Receptor 2	**City of Fray Bentos**
Combustion Products (NO_2, SO_2, PM, PM_{10}, $PM_{2.5}$)	• Air quality remains well below ambient air quality criteria under all meteorological conditions and operating conditions, therefore no adverse human health effects associated with mill emissions.
Reduced Sulphur Compounds (Odour)	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.
Receptor 3	**City of Mercedes**
Combustion Products (NO_2, SO_2, PM, PM_{10}, $PM_{2.5}$)	• Immeasurable change in ambient air quality, well below any level that may cause any effect.
Reduced Sulphur Compounds	• Immeasurable change in ambient air quality, therefore no effect.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.
Receptor 4	**City of Nuevo Berlin**
Combustion Products	• Immeasurable change in ambient air quality, therefore no effect.
Reduced Sulphur Compounds	• Immeasurable change in ambient air quality, therefore no effect.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect
Receptor 5	**Beach Resort of Las Cañas**
Combustion Products	• Immeasurable change in ambient air quality, therefore no effect.
Reduced Sulphur Compounds	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, but at levels similar to that experienced in daily life (e.g., garbage, a poorly tuned car, a sewer).
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.

Table 4.4-1: Summary of Potential Effects of Air Emissions (cont'd)

Receptor 6	**Beach Area of Playa Ubici**
Combustion Products (NO_2, SO_2, PM, PM_{10}, $PM_{2.5}$)	• Air quality remains well below ambient air quality criteria under all meteorological conditions and operating conditions, therefore no adverse human health effects associated with mill emissions.
Reduced Sulphur Compounds (Odour)	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.
Receptor 7	**International Bridge**
Combustion Products (NO_2, SO_2, PM, PM_{10}, $PM_{2.5}$)	• Air quality remains well below ambient air quality criteria under all meteorological conditions and operating conditions, therefore no adverse human health effects associated with mill emissions.
Reduced Sulphur Compounds (Odour)	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.
Receptor 8	**City of Gualeguaychú, Argentina**
Combustion Products	• Immeasurable change in ambient air quality, therefore no effect.
Reduced Sulphur Compounds	• Immeasurable change in ambient air quality, therefore no effect.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.
Receptor 9	**Beach Area at Ñandubaysal, Argentina**
Combustion Products	• Immeasurable change in ambient air quality, therefore no effect.
Reduced Sulphur Compounds	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, but at levels similar to that experienced in daily life (e.g., garbage, a poorly tuned car, a sewer).
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.
Receptor 10	**Beyond the International Bridge, Argentina**
Combustion Products	• Air quality remains well below ambient air quality criteria under all meteorological conditions and operating conditions, therefore no adverse human health effects associated with mill emissions.
Reduced Sulphur Compounds	• Potential for infrequent (up to 10 times per year) detections of odour during upset conditions, and levels may be consider objectionable by someone with a sensitive sense of smell.
Volatile Organic Compounds	• No effect.
Chlorine and Chlorine Dioxide	• No effect.

4.5 Noise

There is a potential for noise impacts related to the construction and operation of the proposed pulp mill developments in Fray Bentos. ENCE also evaluated potentially elevated noise levels resulting from plant decommissioning and as a result of their plantation operations.

The World Bank/International Finance Corporation guidelines for ambient noise state that noise abatement measures should be implemented that will limit noise increases to no more than 3 dB(A) (decibels) above background levels or maximum allowable levels as shown in Table 4.5-1.

Table 4.5-1: World Bank/IFC Ambient Noise Guidelines[12]

Receptor	Maximum Allowable (hourly) in dB(A)	
	Daytime 07:00 – 22:00	Nighttime 22:00 – 07:00
Residential Institutional Educational	55	45
Industrial Commercial	70	70

ENCE recognizes these guidelines but referenced the Chilean standard (Normativa D.S. 146/97) as the standard to be used. In general, the maximum allowable noise levels are comparable in the two systems with the same ranges for similar receptors. Further, the Chilean standard requires noise levels to not increase by more than 10 dB(A) above baseline levels in rural zones. The IFC guideline is to be measured at the project property boundary whereas ENCE described a 1.5 km "area of influence". However, they do not specify if the limits apply throughout this area or at the outer edge. The Botnia EIA does not reference any international standards but refers to the regulations promulgated by the Department of Río Negro. Their EIA notes a municipal regulation of a maximum of 65 dB(A) during the day but does not indicate whether this level is subject to the type of adjacent land uses nor where it should be measured.

4.5.1 ENCE

The EIA document prepared by ENCE notes that noise impacts associated with all phases and operations are reversible and generally of low magnitude. Construction and

[12] International Finance Corporation. Environmental, Health and Safety Guidelines for the Wood Products Industry. Pertaining to Operational Policy on Environmental Assessment (OP 4.01), July 1, 1998.

decommissioning noise impacts are considered short-term whereas operational phase impacts are long-term and plantation noise impacts are long-term but intermittent.

The highest noise levels are anticipated to occur during the plant construction phase due to the presence of many workers along with the movement of vehicles and heavy equipment. Close range noise levels (at 5 m) are predicted to range from 65.5 dB(A) for a hopper wagon to 81.5 dB(A) for large earth movers. They estimate a worse case condition of 84.9 dB(A) at any one time at close range, given the mix of vehicles and machines. This estimate is below that provided by Botnia (see below) during both the construction and operational phases of their facility.

The EIA (Chapter 4) provides a graph showing the fall-off in noise level with distance from the source. The methodology used to prepare the graph is not provided. The data indicate that from a maximum of over 80 dB(A) at source, noise levels would rapidly fall-off with distance, reaching a level of 45 dB(A) at about 500 m from the source. This number is within the maximum allowable limit recommended by the IFC for all receptors, however ENCE does not provide any estimate of construction or operational phase noise levels at their actual property boundary nor do they provide measurements of current levels with which to apply the IFC guidelines. The location of the proposed mill on an island would minimize impacts to human receptors; however, the actual perimeter noise impacts are not fully documented.

Maximum noise levels within plantation areas is estimated in the EIA as being in the order of 75 dB(A) due primarily to harvesting and handling machines. These levels would be confined to areas adjacent to harvesting operations but, given the location of outer portions of the plantations relative to the property boundary, it is likely that the IFC guideline for residential receptors would be exceeded for some adjacent properties and landowners for short periods of time.

Mitigation measures proposed by ENCE to reduce the impact of elevated noise levels include the use of speed limits and signs to control vehicular traffic on-site and the planting of a vegetated border around the perimeter of the plant. No information is provided regarding the timing of the vegetation planting with regard to the construction phase nor are any data provided on the likely effectiveness of such measures in reducing noise levels.

4.5.2 Botnia

The Botnia EIA focuses on the construction and operational phases of the physical plant in Fray Bentos. The document provides a thorough analysis of existing and predicted noise impacts at the perimeter of the facility and beyond. They provide a range of potential noise levels from typical construction equipment at a distance of 15 m. These levels range between 72 and 97 dB(A) for continuous equivalent noise levels, with short-term escalation up to 105 dB(A) for pneumatic equipment. Overall, they note that noise emissions can exceed 100 dB(A) at 15 m during the construction phase.

Operational phase noise levels will be similar to those during construction, with individual machines and process plants ranging from 85 to 103 dB(A). The EIA calculates the attenuation rate between nearby receptors (including, the property boundary, the international bridge, and the Argentine coast) and each of the noted plant processes and machinery. The attenuation calculation is noted to follow the methodological standard defined in by ISO 9613.

Botnia undertook detailed measurements of current noise levels at a variety of locations around the perimeter of the property, at the entrance to the international bridge and on the Argentine side of the river. They also calculated predicted construction phase and operational phase noise levels at the same locations. The predicted noise levels resulting from the operation of the mill were lower than the IFC guideline for residential, institutional and recreational receptors in all cases except at the entrance to the international bridge which would still be below the guideline for commercial receptors.

When they combined the mill contribution with existing noise levels, exceedences of the IFC's incremental guideline above existing (3 dB(A)) were predicted to occur during the evening and day at the entrance to the international bridge and marginally during the evening at the western property boundary on the near side of the Arroyo Yaguareté near a residential area and during the evening on the Argentine coast in front of the mill. In all cases, however the absolute values were still below that recommended by the IFC for commercial or industrial receptors at the bridge (70 dB(A)) and residential, institutional, or recreational receptors at the other two sites (40 dB(A)). Since only one of the absolute and incremental guidelines are required to be met, Botnia's mill will meet the IFC guidelines. These estimated absolute and incremental noise levels did not vary much when mobile sources were incorporated.

Mitigation measures include the use of ear protection equipment by workers, as required in Botnia's health and safety policies, and notification of the local population when exceptionally loud noise will be anticipated during the construction phase.

4.5.3 Summary of Potential Noise Effects

The data provided by ENCE is not sufficient to accurately determine whether or not exceedences of the IFC guidelines will occur. However, some exceedences may occur in areas adjacent to plantations. Detailed measurements and modeling undertaken by Botnia indicate that there will be exceedences of the IFC incremental guideline for noise impacts above existing levels at three receptors but overall, the modeling suggests that they will meet the ambient noise guidelines.

ENCE should undertake detailed monitoring of noise levels adjacent to plantations and the mills to determine whether or not they meet the applicable IFC guidelines. Botnia should continue to undertake monitoring during construction and operation to verify the model results and should also implement monitoring at their plantations. Both companies should prepare contingency plans to protect particularly sensitive receptors in the event of regular

exceedences of IFC guidelines. These contingencies could include sound proofing and deflecting devices including vegetation planting and the construction of noise walls.

Construction phase impacts will be short to medium term and reversible. The plantation impact will be long-term but intermittent. Overall, noise impacts are short term and reversible, and are not considered to be a significant cumulative impact.

4.6 Water Quality Impacts

The potential for effects on the water quality and aquatic resources of the Río Uruguay arising from the treated effluent discharges from the two proposed mills is described in detail in Annex D, Section D6. It is summarized here, with an overview of effluent dispersion and dilution patterns under different river conditions, and a synopsis of potential effects at specific receptor locations of interest as listed in Section 4.1.3.2.

4.6.1 Effluent Exposure in the Río Uruguay

The mathematical models described in Section 4.1.3.1 were used to estimate the patterns of effluent dispersion from the two proposed mills under three river flow conditions: typical flow (6,230 m^3/s), extreme low flow (500 m^3/s) and flow reversal during extreme low flow (a rare, short-term event). For all three scenarios, the effluent discharge rates were 0.83 m^3/s and 0.55 m^3/s, respectively, for the Botnia and ENCE mills. The results are presented in Figures 4.6-1 through 4.6-3 and summarized in Table 4.6-1.

Under typical flow conditions in the river, the combined effluent flow of 1.38 m^3/s is approximately 0.02% of the average river flow. The effluent is rapidly mixed and diluted at each point of discharge, due to the high river flow and the action of the diffuser. The concentration of effluent in the river is reduced to less than 1% (100:1 dilution) within a few metres of the diffuser (Figure 4.6-1). Based on experience in monitoring aquatic effects around paper mills in Canada (Environment Canada, 2003), environmental effects are not anticipated beyond the 100:1 dilution envelope. Trace levels of effluent would extend further downstream, reaching 1,000:1 dilution in the vicinity of Yaguareté Bay. Environment Canada defines areas beyond 1,000:1 dilution as reference areas, and considers them representative of background conditions.

Under extreme low flow conditions in the river (500 m^3/s), the combined effluent flow of 1.38 m^3/s is approximately 0.28% of the river flow. This low flow in the river has a recurrence interval in the range of 5 to 20 years. In this case, the 100:1 dilution envelope extends approximately 35 m downstream from each diffuser and 200 m along the length of the diffuser (Figure 4.6-2). The small size of this exposure area minimizes any potential for effects on fish, since fish usually range over much larger areas. In its environmental effects monitoring program for paper mills, Environment Canada (2005) has determined that a survey for effects on fishes is not required when 100:1 dilution is achieved with 250 m of the mill discharge. Trace levels of effluent would extend further downstream, reaching 200:1 dilution in the vicinity of Fray Bentos.

During a rare flow reversal condition, with low flow, the effluent plumes may extend upriver, again reaching 100:1 dilution within approximately 35 m of the discharge (Figure 4.6-3). Trace levels of effluent would extend further upstream, to a maximum extent of 7 km above the ENCE mill, at 1,000:1 dilution. The reverse flow condition would not last for more than a few hours. During this time, trace levels of effluent could extend across the Río Uruguay into Argentina waters at a 700:1 dilution level. These flow reversals are caused by a rapid change in water elevation in the Rio de la Plata in the order of 1 m or more over a few hours and occur only during low flow periods. This situation is expected to occur a few times per year or less frequently.

Definitions for exposure areas (less than 100:1 dilution) and reference areas (greater than 1000:1 dilution) are from Environment Canada (2005). Environment Canada has developed an Environmental Effects Monitoring program for the pulp and paper sector in Canada. This program is the most comprehensive monitoring program in the world for assessment of the potential effects of pulp and paper effluents on the natural aquatic environment. The program began in the early 1990's and has since generated a detailed database from which Environment Canada has defined the exposure and reference areas.

4.6.2 Potential for Effects at Receptor Locations

The receptor locations are individually discussed in the following paragraphs, with reference to particular effluent constituents and potential effects.

4.6.2.1 Water Receptor 1, Río *Uruguay at the Botnia and ENCE Diffusers*

The treated effluents from the Botnia and ENCE mills will be discharged to the Río Uruguay through diffuser structures located 200 m offshore from the river bank in 13.5 m and 19 m of water, respectively. Under the most extreme condition (low river flow), the 100:1 effluent dilution envelope will extend approximately 35 m downstream from each diffuser. Typically, this exposure envelope will extend only a few metres downstream.

The greatest potential effect within these relatively small areas is of an aesthetic nature. There is a slight risk that the discharge for the Botnia mill may be visually detected under extreme low flow conditions by an observer standing on the International Bridge. The close proximity of the Botnia mill to the International Bridge provides a clear view of the diffuser area, whereas the ENCE mill is too far away to view the diffuser area from the bridge. The proximity of the Botnia diffuser to the bridge may enable visual detection of the slight change in color of the wastewater relative to the ambient river water and the possible slight disturbance of the surface flow pattern due to the turbulence from the diffuser nozzles. This visual detection of the plume could be objectionable to the public as it may be perceived as an environmental risk, although such detection does not pose any real risk to either public safety or to the environment. These subtle differences are not likely detectable from a boat.

The water quality within this extremely small exposure area will not pose a risk to humans or aquatic life. The water quality may exceed one or more of the surface water quality

standards of DINAMA and CARU during periods of extreme low flow, although this potential is provided for within the regulatory standards (referred to as a mixing zone). The areas of potential exceedance are relatively small and are confined to areas within the main channel on the Uruguayan side of the river away from sensitive habitat, valued recreational areas and drinking water supplies. They therefore do not pose a direct risk to the valued components of the ecosystem.

Fish may be attracted to these areas because of warmer temperatures and higher velocity immediately at the diffusers. However, the size of this area of exposure is so small relative to the home range for most fish species that the potential for effects on fish is considered minimal. Experience at pulp mills in Canada shows that fish health responses are non-measurable within such small exposure areas.

Beyond the edge of the mixing zone, the water quality of the Río Uruguay will be in compliance with all surface water quality standards with the exception of those water quality parameters in exceedance under existing conditions. As described in Section 3.2.2, the baseline concentration of phosphorus and several metals exceed the surface water quality standards throughout the Río Uruguay under existing conditions. The discharge of untreated municipal and industrial wastewaters, agricultural fertilizers and other agricultural runoffs all contribute to this existing condition.

Sediments within the immediate vicinity of the diffusers (extending 35 m from the diffuser) may be enriched with nutrients (organic material, nitrogen, phosphorus) as is commonly found near pulp mill diffusers, and this enrichment may cause a change in the benthic macroinvertebrate community. However, given the extremely small size of the exposure area and high mobility of sediments at moderate and high flows in the main channel, the extent of enrichment is expected to be limited and perhaps transient.

4.6.2.2 Water Receptor 2, Río Uruguay at Yaguareté Bay

The Yaguareté Bay is a shallow embayment located approximately 1.5 km downstream from the Botnia discharge. It has been identified as a potentially sensitive aquatic environment since it provides important habitat for various species of fish.

With water depth less than 2 m, it comprises a particularly extensive littoral zone, similar to those existing in other embayments both up and downriver. In general, this littoral zone tends to be more productive than the profundal zone of a river and, as such, tends to be used as a feeding area for many fish species, particularly benthivorous species such as catfish and carp. In addition, juvenile fishes of many species feed in these areas due to the high bottom productivity and low density of predatory fishes. Both carp and catfishes tend to use shallow embayments for spawning purposes, and this likely occurs in Yaguareté Bay, as in other shallow embayments up and down the river.

Water velocity is lower in Yaguareté Bay as compared to the main channel, and as such, sedimentation may occur more readily in the embayment than further offshore. At the same

time, the embayment is regularly flushed during high flow periods and due to wind/wave action, as evidenced by the lack of sedimentary features (e.g., islands). An investigation of the potential influence of the port development (Botnia, 2006) estimated a potential change in the sedimentation rate from 0.13 m/a under present conditions to 0.19 m/a with the development of the port. However, these estimates of sedimentation are unrealistically high considering they would cause the embayment to fill within 10 to 15 years under present conditions. Calculations (Yalin, 1992; Dean and Dalrymple, 1984) show that currents of 0.25 m/s and waves of 0.5 m can mobilize silt size sediment in 2 m of water, and therefore these other factors are expected to prevent accumulation of sediment within the embayment.

Suspended sediment discharged from the two mills will not affect the net sedimentation rate within Yaguareté Bay since the potential change in concentration of suspended solids is exceedingly low. The change in total suspended solids concentration within the embayment is estimated to range from 0.0 mg/L under average flow to 0.5 mg/L under extreme low flow conditions within the Río Uruguay. In comparison, the baseline concentration of total suspended solids is approximately 14 mg/L and can range from 2 to 58 mg/L (CARU, 1993). Thus, it is expected that suspended solids will not measurably change in or near Yaguareté Bay as a result of mill operations, and accordingly, net sedimentation in the bay is not expected to change.

Nutrification is a potential issue for Yaguareté Bay under existing conditions, since algal blooms can occur in the embayment during the summer months. Baseline concentrations of total nitrogen and total phosphorus range from 0.19 to 1.1 mg/L and 0.04 to 0.24 mg/L, respectively (CARU, 1993; Algoritmos, 2006) in comparison to surface water quality standards for total phosphorus of 0.025 mg/L. (A surface water quality standard does not exist for total nitrogen). The discharge from the two mills will not change the concentrations of total nitrogen and total phosphorus in or near Yaguareté Bay under average flow conditions, and will not measurably change the concentrations under extreme low flow conditions (increments 0.04 and 0.001 mg/L). Nutrient levels in sediments are unlikely to be measurably changed as a result.

The concentration of chlorinated organics will also remain unchanged in or near Yaguareté Bay as a result of mill operations. Chlorophenolics are the main chlorinated constituents in the mill effluents. Baseline levels of chlorophenolics in the waters of Yaguareté Bay range from approximately 0.0001 mg/L (Tana, 2005, 2006) to 0.0014 mg/L (Algoritmos, 2006). They will not change under average flow conditions and may change marginally by 0.0003 mg/L under extreme low flow conditions. While chlorophenolics may partition to sediments and benthic invertebrates, with minimal changes in water quality and sedimentation in the bay, the levels in sediments and biota are not expected to be measurably changed.

A conservative estimate of the dioxin and furan concentrations in the Botnia and ENCE mill effluents is less than 10 pg/L TEQ (note 1 pg/L is equivalent to 10^{-9} mg/L). Based on this

conservative estimate, the TEQ concentration within Yaguareté Bay may change by less than 0.035 pg/L TEQ under extreme low flows, as compared to baseline levels as high as 0.46 pg/L TEQ in the Río Uruguay (Tana, 2005, 2006). This small increment would not measurably change the baseline water quality for dioxins and furans within Yaguareté Bay. Furthermore, the concentration of the most toxic congener (2,3,7,8-TCDD) is expected to be non-detectable (at the 0.5 pg/L level) within the effluent, and therefore water in Yaguareté Bay will be significantly less than the water quality guideline of 0.005 pq/L defined by the U.S. EPA (2002) for protection of fish consumption. Consequently, the concentrations of dioxins and furans in fish tissue are not expected to be measurably changed as a result of releases from the mill.

The baseline concentrations of dioxins and furans in fish tissue are in the 0.1 to 0.3 pg TEQ/g FW[13] range (Tana, 2005, 2006). These values are 13 to 200 times lower than the TEQ levels at which fish consumption advisories would begin. Thus, there is a considerable margin of safety at present with respect to dioxins and furans, and this will continue to be the case when the mills are operating.

While adverse effects from chlorinated organics in Yaguareté Bay are not anticipated, monitoring of chlorophenolics and dioxins and furans in the sediments and biota of the bay is recommended to confirm that there is no measurable increase in the levels of these substances. A proposed monitoring program is outlined in Section 5.1.4.

Phytosterols in Botnia mill effluent are expected to be 0.020 to 0.160 mg/L. In ENCE mill effluent, they are expected to be less than 0.170 mg/L. The phytosterols will be diluted at least 300:1 in Yaguareté Bay under the worst case condition, resulting in a potential change in concentration of less than 0.001 mg/L. This increment is below the baseline range for the Río Uruguay of less than 0.001 to 0.022 mg/L (Tana, 2005, 2006). It is also below the threshold level of 0.010 mg/L for β-sitosterol induction of estrogenic effects in fishes, and well below the levels that have been associated with reproductive effects in wild fishes (Munkittrick *et al.*, 1998; McMaster *et al.*, 2003; Golder, 2006). It is therefore concluded that effects are very unlikely to be observed in fishes in the vicinity of Yaguareté Bay.

Similarly, fish tainting is very unlikely to be detected in the area as a result of mill operations. Even with older bleached kraft mill technologies, fish tainting has not been associated with effluent concentrations below about 25:1 to 50:1 dilution (Kovacs, 1986). In comparison, the effluent concentrations in Yaguareté Bay are estimated to be significantly lower at the 300:1 level or better. Tainting related to mill effluents is generally not observed today (Environment Canada, 2003) and is never observed in the vicinity of modern mills with good secondary treatment.

[13] FW refers to fresh weight

4.6.2.3 Water Receptor 3, Playa Ubici at the Downstream Edge of Yaguareté Bay

Playa Ubici is a recreational beach area located along the downstream edge of Yaguareté Bay approximately 1,500 m from the Botnia discharge. The beach is a valuable resource for the city of Fray Bentos and for tourists who may visit the area. It is used for camping, swimming and other outdoor recreational activities.

Under existing conditions, the water quality along the waterfront of Playa Ubici is in compliance with the surface water quality standards of DINAMA and CARU for all listed parameters with the exception of total phosphorus and possibly bacteria. These two water quality parameters are generally of greatest interest from the perspective of recreational water contact. Phosphorus is of interest as it promotes growth of algae which can affect the aesthetic quality of the water and beach front, and certain species can pose a health risk to humans and aquatic life. Bacteria serve as an indicator of the possible presence of pathogens associated with fecal contamination which pose a risk to human health.

Mill operations will have no effect on the quality of this valued resource and therefore there are no adverse effects to human health or aquatic life. The contribution of phosphorus from mill operations is predicted to be immeasurably small (0.003 mg/L under extreme low flows) in comparison to background of 0.130 mg/L (Algoritmos, 2006). Likewise, the contribution of mill operations to bacteria levels will also be immeasurably small relative to the recreational standard of 200 F.C./100 mL. As a result, algal biomass and pathogens associated with fecal material will remain unchanged.

4.6.2.4 Water Receptor 4, Fray Bentos Drinking Water Intake

The water intake for the community of Fray Bentos is located approximately 5 km downstream from the Botnia site, and about 70 m into the Río Uruguay. The water supplier (OSE) withdraws approximately 0.05 m^3/s and distributes treated water to approximately 22,600 people. The treatment includes flocculation (by alum addition), sedimentation, filtration, disinfection with chlorine and pH adjustment. The chlorine residual in the finished drinking water is typically about 0.8 mg/L.

Primary water quality indicators for potability of water relate to the colour, taste, smell and coliform bacteria count. The first three are aesthetic issues. The latter is not a health concern per se, but serves as an indicator that microbial disease organisms may be present. Water quality associated with chlorinated organic compounds, such as dioxins, furans and chlorophenols, are also of interest from a human health perspective. Nitrites and nitrates are also of interest from a human health perspective. WHO guidelines for nitrite and nitrate in drinking water are 3 and 50 mg/L, respectively.

Baseline OSE data for 2000 to 2003 indicate nitrite concentrations of less than 0.01 mg/L and nitrate concentrations of less than 11 mg/L in the river water supply. Botnia (2004) presents data for nitrate at this location in the 1 to 2 mg/L range. Recent data for this general area in 2005 and 2006 indicate values may be as high as 5.9 mg/L. Nitrates in mill

effluents (3 to 10 mg/L) are expected to be below levels of drinking water concern at the point of discharge, and 1,500 times below WHO guidelines at the Fray Bentos water supply.

Adsorbable organic halide (AOX), often used as a surrogate for chlorinated organic compounds, is in the 0.002 to 0.007 mg/L range at the water intake location (SEINCO, 2003). Botnia (2004) data for this location are in the 0.007 to 0.008 mg/L range, and recent data for this general area indicate values may be as high as 0.012 mg/L. AOX in mill effluents is expected to be diluted to the 0.003 to 0.043 mg/L range at the intake location under the average and extreme low flow conditions, respectively. The higher value would suggest that a new source of chlorinated organics may be present; however, at most, a small fraction of the AOX might be in the form of toxic chlorinated organics. In the case of modern ECF mill effluents, chlorophenolics might comprise up to about 1 or 2% of AOX.

It should be noted that AOX may be formed as part of the drinking water treatment process through chlorination, particularly when there are high levels of organic substances in the raw water. Chemical oxygen demand (COD) is a general indicator of organic substances. The baseline COD concentration at the intake ranges from 1 to 2 mg/L reported by Botnia (December, 2003) and to 20 mg/L reported by GTAN (2006). The incremental contribution from the mill operations is predicted to range from 0.3 to 4.1 mg/L for the average and extreme low flow conditions, respectively. Thus, there is limited potential for organics from the mills to increase the production of AOX within the water supply facility.

Since AOX levels of 0.050 to 0.100 mg/L in drinking water are not considered problematic (Grimvall *et al.*, 1994; McCubbin, 2001; Norrstrom and Karlsson, 2006), and since the mill projects on the Río Uruguay are likely to make a small change in AOX levels (up to about 0.05 mg/L during low flow), there is little likelihood of mill effects on the Fray Bentos water supply related to chlorinated organics.

Most modern North American mills report “non-detect” for TCDD in final effluent (at detection limits up to 10 pg/L) and roughly half report occasional detection of TCDF (which may represent river baseline conditions). McCubbin (2001) notes that there has never been proven damage to water users in North America due to TCDD/TCDF in mill effluents, despite the fact that until the 1990s, all mills discharged much greater amounts of TCDD/TCDF than do modern ECF kraft mills.

Consideration of chlorophenols in mill effluents would support the expectation of no adverse effects on the drinking water supply from chlorinated organics. With expected effluent concentrations of approximately 0.070 mg/L and worst case dilution, the concentration in the river near the discharge will be less than 0.0007 mg/L. This is within the baseline range of up to 0.0014 mg/L (Algoritmos, 2006). It is also well below the Health Canada guideline of 0.005 mg/L for 2,4,6-trichlorophenol, the most toxic of the listed chlorophenolics.

It is concluded that the quality of water at the Fray Bentos water supply will remain protective of human health.

4.6.2.5 Water Receptor 5, Beach Area near Arroyo Fray Bentos

The beach area near Arroyo Fray Bentos is a valued resource for the city of Fray Bentos and is used for swimming and other outdoor recreational activities.

The beach is located downstream from the municipal wastewater discharge for the city of Fray Bentos. It is reported that this beach area experiences elevated levels of phosphorus and fecal coliform bacteria as a result of its close proximity to the municipal discharge. The average contribution of this discharge to phosphorus and bacteria is predicted to be 0.01 mg/L and 70 FC/100 mL. Higher concentrations are expected during periods of heavy rainfall. Elevated phosphorus concentrations contribute to the growth of algae which can impact the aesthetic quality of the beach area..

Botnia is considering the option of treating the municipal wastewater for Fray Bentos at the wastewater treatment system for the mill. This will effectively eliminate this significant source of phosphorus and bacteria to this beach area thereby improving the overall quality of the resource. This is considered a significant benefit that should be considered further by DINAMA, the city of Fray Bentos, Botnia and other stakeholders.

The mill operations will have no adverse effects on human health or aquatic life, although the option of treating the municipal wastewater will improve water quality of this resource and reduce the potential health risk attributed to the present levels of bacteria.

4.6.2.6 Water Receptor 6, Beach Area at Las Cañas

Las Cañas is a beach resort community located further downstream along the shores of the Río Uruguay. The beach attracts visitors from throughout Uruguay and Argentina, and is therefore an important resource for local tourism.

The beach is also located downstream from the municipal discharge for the city of Fray Bentos. The contribution of phosphorus and bacteria along the shores from this discharge is predicted to be 0.005 mg/L and 30 F.C./100 mL, on average, and potentially considerably higher during heavy rainfall. The treatment of the Fray Bentos discharge by the Botnia mill will eliminate this source of wastewater to Las Cañas and is therefore considered a benefit.

The mill discharges are sufficiently far upstream that the water quality at Las Cañas will remain unchanged as a result of mill operations.

4.6.2.7 Water Receptor 7, Río de la Plata

The Río de la Plata is an estuary formed by the combination of the Río Uruguay and the Río Paraná. It extends approximately 290 km from the rivers' confluence to the Atlantic Ocean. Where the rivers join, it is 48 km wide, and it runs to the southeast increasing to 220 km wide where it opens on the Atlantic Ocean. It forms part of the border between

Argentina and Uruguay, with the major ports and capital cities of Buenos Aires in the southwest and Montevideo in the northeast.

The basin drained by the main tributaries of the Río de la Plata (the Uruguay and Paraná, and the Paraná tributary, the Paraguay) covers approximately one fifth of South America, including areas in southeastern Bolivia, southern and central Brazil, the entire nation of Paraguay, most of Uruguay and northern Argentina. The average flow from this massive drainage area is approximately 24,000 m^3/s, in comparison to the average flow of the Río Uruguay of approximately 6,200 m^3/s.

Given the magnitude of flow within the Río de la Plata, the wastewater discharge from the two mills will have no effect on water quality. All resources within the Río de la Plata will therefore be unaffected by the mill operations.

4.6.2.8 Water Receptor 8, Esteros de Farrapos e Islas del Río Uruguay

Esteros de Farrapos e Islas del Río Uruguay is Uruguay's second designated Ramsar site. In 2004, it was added to the List of Wetlands of International Importance and incorporated into the National Protected Area System. Located along the Río Uruguay between Neuvo Berlin and San Javier, the site consists of alluvial areas on the river's eastern bank as well as 24 islands that are periodically flooded during periods of high flow. The site is a representative wetland of the transition zone between the humid temperate and the subtropical areas. The site supports a high diversity of birds and serves as an important wildlife refuge and corridor.

This area will not be exposed to wastewaters from the mill operations. During most flow conditions, the downstream direction of flow carries the wastewaters from the two mills away from this area thereby preventing all risk of exposure. During rare occasions when the flow reverses direction and travels upstream, the wastewaters move upstream at trace levels, although the dilution is expected to be greater than 1,000:1 at a point 7 km upriver from ENCE, well below the Island Delta area, and the plume would extend this far only for a few hours. Therefore, there is virtually no potential for mill effluents to impact the Island Delta area.

4.6.2.9 Water Receptor 9, Río Negro

The Papelera Mercedes is a neutral sodium sulphite chemical (NSSC) and Kraft mill located along the Río Negro in the community of Mercedes. This mill does not have any form of chemical recovery or wastewater treatment, and all cooling and process waters are discharged directly to the Río Negro where it then flows to the Río Uruguay.

Botnia is considering the option of recovering the weak black liquor from Papelera Mercedes. Recovery of the weak black liquor by Botnia represents a significant environmental and social benefit. From an environmental perspective, the option results in a significant benefit to the Rio Negro and Rio Uruguay as it will eliminate this source of

potentially harmful chemicals to the rivers. This option will reduce the total COD, BOD and phosphorus load to the Rio Negro and Rio Uruguay by approximately 22, 8 and 0.004 t/d, respectively. This offsets the net loading of organics and reduces the net nutrient loading from the Botnia mill. It will also reduce the total loading of caustic soda and sulphuric acid by 3.5 and 1.8 t/d, respectively, generate an additional 0.5 MW of electrical power, and generate 1.5 MW of steam.

From a social perspective, this option may ensure the economic viability of the Mercedes mill since the cost of treatment on-site is not viable for the small production capacity of the mill. This option warrants further consideration by DINAMA, Papelera Mercedes, Botnia and other stakeholders.

4.6.2.10 Water Receptor 10, Río Uruguay on the Argentina Side

As with Uruguay, Argentina values the Río Uruguay as a resource for drinking water, irrigation water, recreation, and habitat for valued aquatic species. Protection of this resource is a priority of the people of Argentina and their Government. As such, the Government of Argentina, together with the Government of Uruguay, established CARU as the agency responsible for the oversight of the protection and monitoring of water quality within the Río Uruguay. CARU has developed water quality standards that the mills must comply with. These standards are approved by the Governments of Argentina and Uruguay and are considered by these Governments as acceptable and adequately protective of the aquatic environment of the Río Uruguay.

The mill operations will comply with the water quality standards provided by CARU.

The wastewaters from the mill operation will remain on the Uruguayan side of the river and will not cross over to the Argentina side beyond trace levels. Under average and extreme low flows, the dilution of mill wastewaters in Argentina waters will exceed 1,000:1 and therefore are considered the same as background from the perspective of water quality and aquatic resource protection. During rare flow reversals the dilution may reduce below 1,000:1; however, the contribution of mill effluents to water quality within Argentina waters will remain extremely small and well within the standards provided by CARU.

Fish and other aquatic animals move throughout the Río Uruguay and may reside in water along both Uruguay and Argentina sides of the river. The aquatic resources within Yaguareté Bay are not expected to be adversely affected by mill operations (Section 4.6.2.2), and therefore fish species that move between Yaguareté Bay and Argentina are also considered to be protected from the perspective of the mill operations. It is worth noting that many of the valued fish species of the region spend early life stages in Argentina waters along the Río Paraná.

4.6.2.11 Water Receptor 11, Beach Area at Ñandubaysal, Argentina

A beach and campground is located at Ñandubaysal in Argentina across the Río Uruguay from Fray Bentos. The site is a popular vacation and tourist destination for people from Argentina and Uruguay during the summer months and particularly during the annual Carnival.

The existing water quality at the beach area is within the standards for both CARU and DINAMA with the exception of phosphorus, several metals and possibly bacteria. These elevated levels reflect a general concern throughout the Río Uruguay associated with the discharge of untreated municipal and industrial wastewaters and agricultural runoff. Given its close proximity, the quality of water at Ñandubaysal is likely most influenced by the water quality of the Río Gualeguaychú.

Dispersion modeling shows that wastewaters discharged along the Uruguayan side of the river tend to remain along the shoreline and do not disperse across the river, particularly within such a short distance from the source. Studies conducted by CARU reach the same conclusion. The calculated dilution at the beach area at Ñandubaysal exceeds 1,000:1 under both average and low flow conditions (Table 4.6-1), and therefore is considered to be unaffected by mill operations.

On rare occasions the flow of the river may reverse direction and during these rare occasions the model predicts movement of trace levels of wastewater across the Río Uruguay towards Ñandubaysal. A dilution of approximately 700:1 is sufficient to reduce the concentration of wastewater to non-measurable levels. AOX may be a possible exception since it can be detected at trace levels. However, the predicted contribution from mill operations of 0.007 mg/L is within the range of observed background levels and is not considered problematic for drinking water or protection of human health or aquatic life.

4.6.3 Summary of Potential Effects on the Aquatic Environment

Table 4.6-2 provides a summary of the potential effects on the aquatic environment associated with the mill operations. As presented, potential effects are limited to the area within the immediate vicinity of each diffuser where the effluent initially mixes with the ambient water. Beyond this small area, the water quality standards are achieved with the exception of those parameters which exceed the standards under present conditions due to the discharge of untreated municipal wastewater and agricultural runoff. The mill discharge will therefore have no adverse effect on human health or aquatic life. Options under consideration for treatment of the municipal wastewater for the city of Fray Bentos and treatment of the industrial wastewater for Papelera Mercedes could result in significant improvements to the water quality downstream of Fray Bentos and within the Río Negro, and may reduce the present risk to human health caused by existing bacteria levels.

Table 4.6-1: Effluent Exposure at Receptor Locations for Various Flow Conditions

Receptor	Average Flow (6,230 m^3/s) Dilution	Extreme Low Flow (500 m^3/s) Dilution	Flow Reversal during Low Flow (700 m^3/s) Dilution
Conductivity of Effluents	-	-	-
Conductivity of Ambient River	-	-	-
Uruguay			
1. At each discharge	-	100:1	100:1
2. Yaguareté Bay	>1,000:1	>1,000:1	516:1
3. Playa Ubici	>1,000:1	246:1	757:1
4. Fray Bentos water intake	>1,000:1	164:1	784:1
5. Beach area at Arroyo Fray Bentos	>1,000:1	220:1	>1,000:1
6. Beach area at Las Cañas	>1,000:1	247:1	>1,000:1
7. Rio de la Plata	>1,000:1	>1,000:1	>1,000:1
8. Rio Uruguay Island Delta	>1,000:1	>1,000:1	>1,000:1
9. Rio Negro	N/A	N/A	N/A
Argentina			
10. Rio Uruguay in Argentina	>1,000:1	>1,000:1	895:1
11. Beach area at Ñandubaysal	>1,000:1	>1,000:1	693:1

Table 4.6-2: Summary of Potential Effects on the Aquatic Environment

Receptor 1	**Vicinity of Botnia and ENCE Discharges**
Water quality	• Exposure Area extending approximately 35 m from each diffuser and 200 m along each diffuser. • Possible exceedance of surface water quality objectives within this exposure area during extreme low flow conditions. • Potential for aesthetic effect associated with visual detection of the effluent plume within a very small area at each diffuser during extreme low flow conditions.
Sediment quality	• Possible enrichment of sediments (e.g., organic material and nutrients) within the small exposure area at each diffuser.
Fish community	• Possible fish attraction to the diffusers due to warmer temperature and higher velocity. • Minimal potential health effects on fish, since exposure area is small relative to the home range for most fish species.
Aquatic invertebrate community	• Possible change in benthic macroinvertebrate community within the exposure area at each diffuser due to sediment enrichment.
Receptor 2	**Yaguareté Bay**
Water quality	• Water quality in compliance with DINAMA surface water quality standards (with the exception of phosphorus which exceeds the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality.
Sediment quality	• Potential for sedimentation due to the lower water velocities within the embayment but limited change expected due to mill operations. • Monitoring of sediment quality recommended to confirm conclusion of no adverse effect.
Fish community	• Trace levels of wastewater from mill operations will not adversely affect the health of fish communities within Yaguareté Bay. • Monitoring of selected fish species recommended to confirm conclusion of no adverse effect.
Aquatic invertebrate community	• Trace levels of wastewater from mill operations will not adversely affect the invertebrate communities within Yaguareté Bay. • Monitoring of benthic macroinvertebrate community recommended to confirm conclusion of no adverse effect.

Table 4.6-2: Summary of Potential Effects on the Aquatic Environment (cont'd)

Receptor 3	**Playa Ubici**
Water quality	• Water quality in compliance with DINAMA surface water quality standards (with the exception of phosphorus and possibly bacteria which exceed the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality.
Sediment quality	• Sediment quality unaffected within beach area.
Fish community	• Fish community unaffected within beach area.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected within beach area.
Receptor 4	**Fray Bentos Drinking Water Supply**
Water quality	• Water quality in compliance with DINAMA surface water quality standards for Class 1 waters (with the exception of phosphorus, ammonia and possibly bacteria which exceed the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality nor affect human health.
Sediment quality	• Not applicable
Fish community	• Not applicable
Aquatic invertebrate community	• Not applicable
Receptor 5	**Beach Area near Arroyo Fray Bentos**
Water quality	• Water quality in compliance with DINAMA surface water quality standards (with the exception of phosphorus and possibly bacteria which exceed the standard under background condition due to discharge of untreated municipal wastewater and agriculture runoff). • Trace levels of wastewater from mill operations will not adversely affect water quality. • Option to treat the municipal wastewater for the city of Fray Bentos at the Botnia mill will improve water quality within the beach area.
Sediment quality	• Sediment quality unaffected within beach area.
Fish community	• Fish community unaffected within beach area.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected within beach area.
Receptor 6	**Beach Area near Las Cañas**
Water quality	• Potential for improved water quality if municipal wastewater for the city of Fray Bentos is treated at the Botnia mill.
Sediment quality	• Sediment quality unaffected within beach area.
Fish community	• Fish community unaffected within beach area.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected within beach area.

Table 4.6-2: Summary of Potential Effects on the Aquatic Environment (cont'd)

Receptor 7	**Rio de la Plata**
Water quality	• Water quality unaffected.
Sediment quality	• Sediment quality unaffected.
Fish community	• Fish community unaffected.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected.
Receptor 8	**Esteros de Farrapos e Islas del Rio Uruguay**
Water quality	• Water quality unaffected.
Sediment quality	• Sediment quality unaffected.
Fish community	• Fish community unaffected.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected.
Receptor 9	**Rio Negro**
Water quality	• Potential improvement in water quality in Rio Negro if untreated wastewater from Papelera Mercedes is treated at Botnia mill.
Sediment quality	• Potential improvement in sediment quality in Rio Negro if untreated wastewater from Papelera Mercedes is treated at Botnia mill.
Fish community	• Reduced risk to fish community in Rio Negro if untreated wastewater from Papelera Mercedes is treated at Botnia mill.
Aquatic invertebrate community	• Reduced risk to invertebrate community in Rio Negro if untreated wastewater from Papelera Mercedes is treated at Botnia mill.
Receptor 10	**Rio Uruguay along the Argentina Side**
Water quality	• Water quality unaffected.
Sediment quality	• Sediment quality unaffected.
Fish community	• Fish community unaffected.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected.
Receptor 11	**Beach Area at Ñandubaysal, Argentina**
Water quality	• Water quality unaffected.
Sediment quality	• Sediment quality unaffected.
Fish community	• Fish community unaffected.
Aquatic invertebrate community	• Aquatic invertebrate community unaffected.

Figure 4.6-1: Effluent Exposure under Typical Flow Conditions

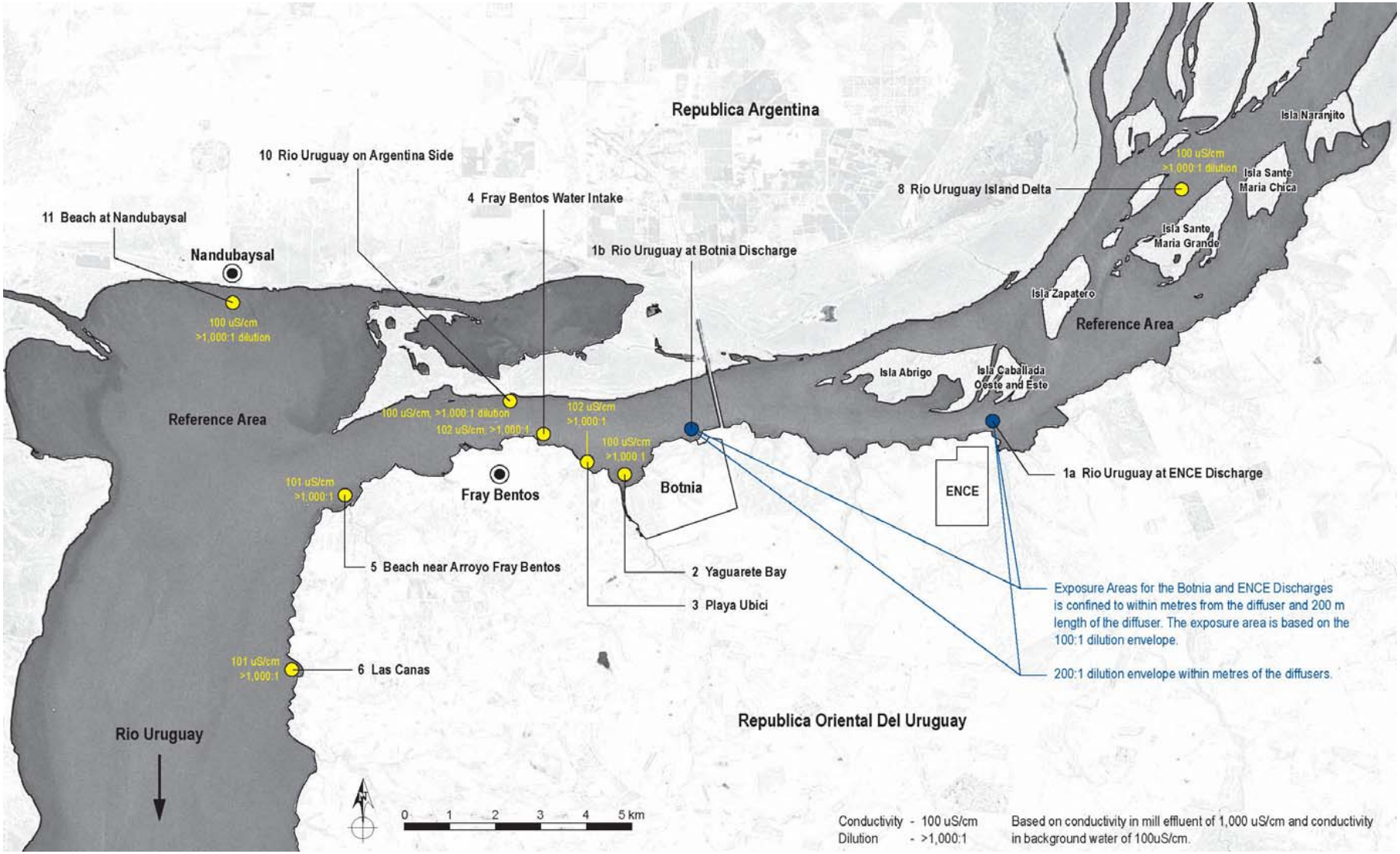


Figure 4.6-2: Effluent Exposure under Extreme Low Flow Conditions

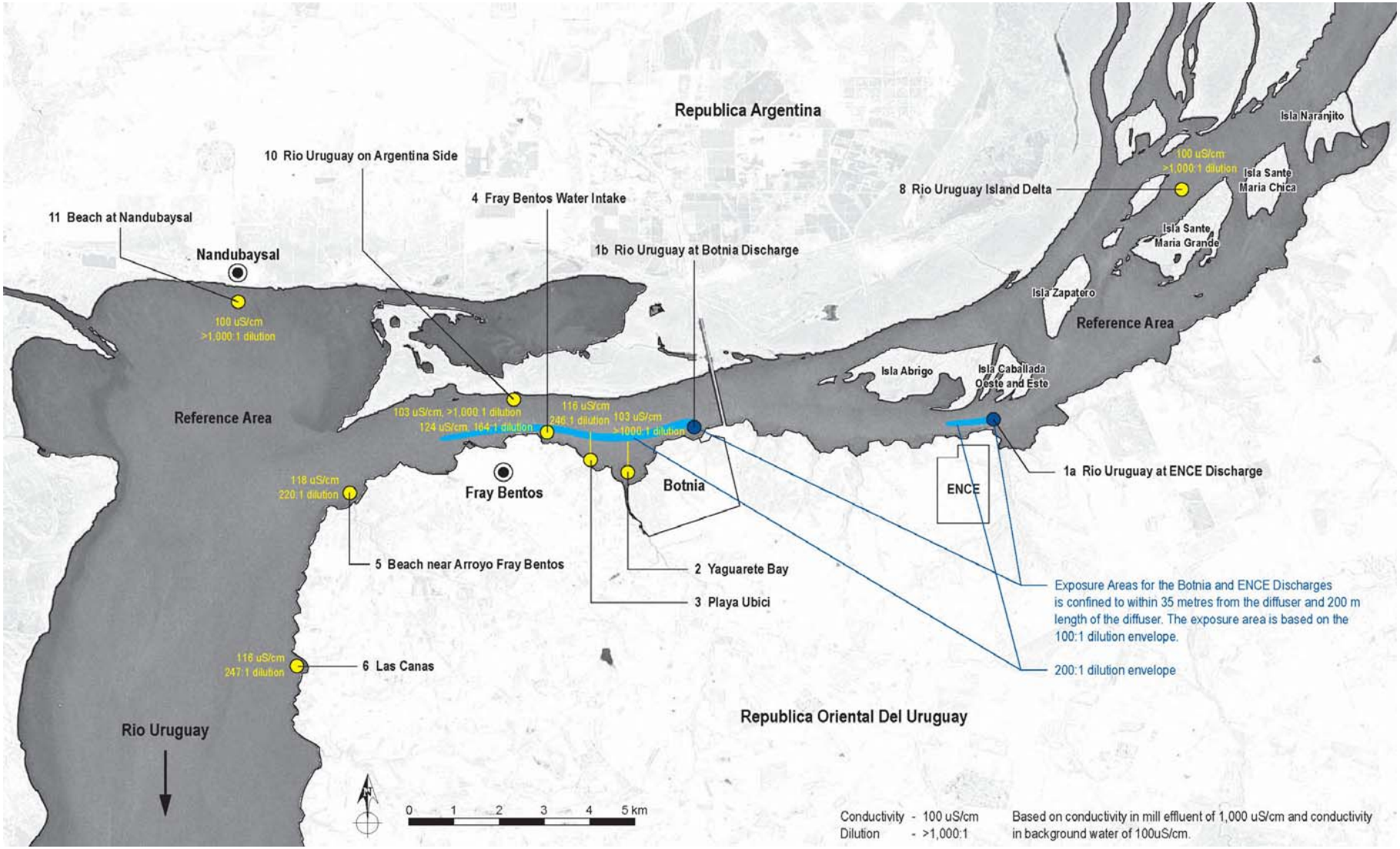
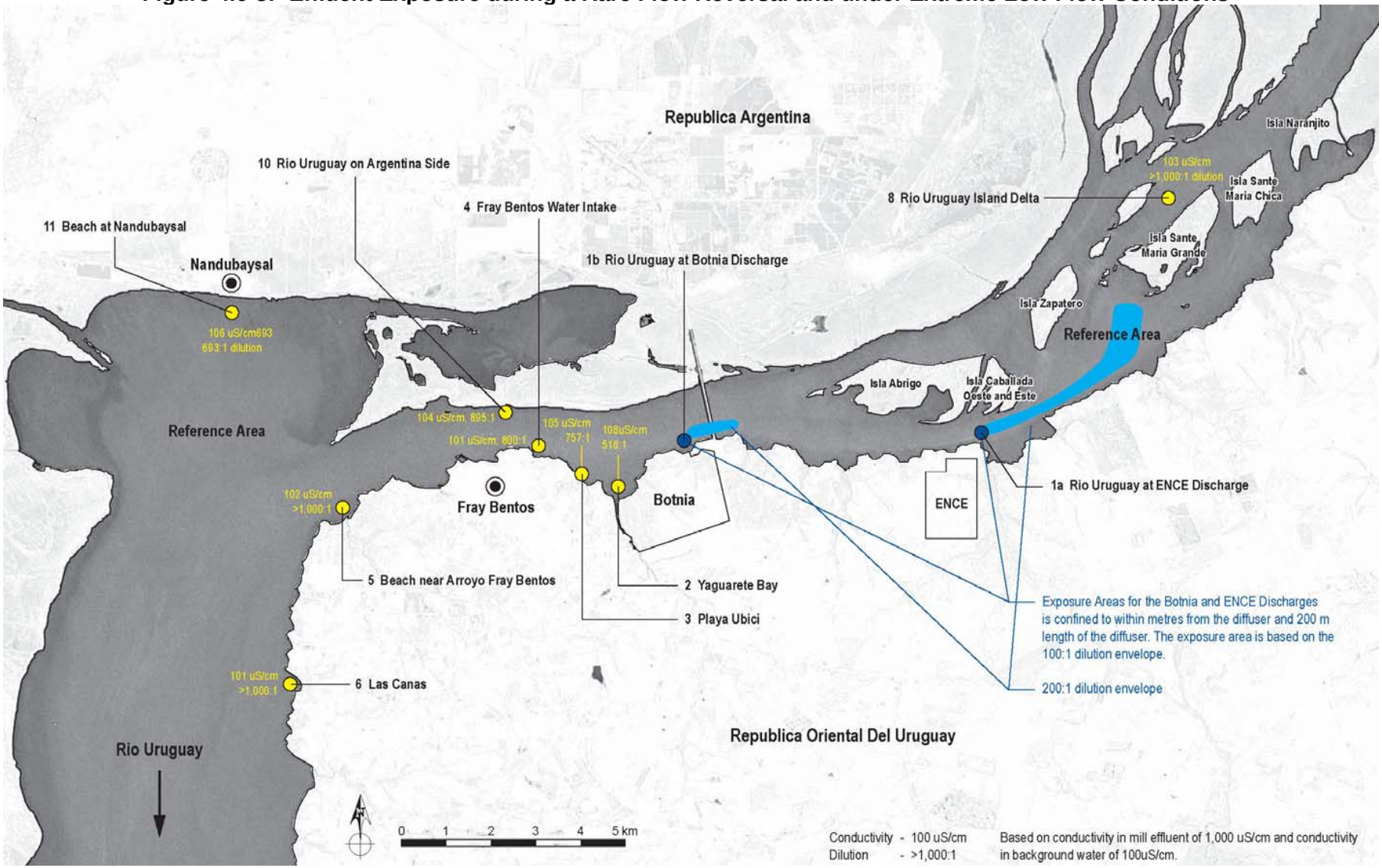


Figure 4.6-3: Effluent Exposure during a Rare Flow Reversal and under Extreme Low Flow Conditions



4.7 Solid Waste

Best available techniques for solid waste management involve minimizing the generation of solid waste by recovering, recycling and reusing waste materials wherever practicable. These actions as well as innovative waste minimization techniques that will be adopted by the mills are described in Annex A. In this section, the types of solid waste, the design of the landfills, and hazardous waste handling techniques will be discussed.

Solid wastes generated by Kraft pulp mill operations generally consist of the following:

- Wood Preparation Waste – bark, sand, grit and other debris associated with wood handling and preparation.
- Raw Water Treatment Sludge – mixed organic and inorganic materials resulting from the chemical treatment and filtration of water for use in the production process.
- Green Liquor Dregs, Grit and Lime Mud – primarily inorganic solids generated from the chemical recovery process. They consist of impurities from the wood or chemicals used in production that must be removed to prevent build up of inert materials and non-process chemicals.
- Effluent Treatment Sludge – generated from the primary and secondary treatment of effluent. Primary sludge is a combination of non-recoverable fiber from the pulp mill and inorganic materials (mostly lime mud and $CaCO_3$) which settles in the primary clarifier. Secondary sludge is mostly excess organic biomass from biological wastewater treatment.
- Ash/Sands – generated from combustion of wood residues and sludges and usually include solids recovered by air pollution control systems.
- Municipal Solid Waste – generated from non-production processes such as offices, kitchens and building materials from construction and workshop areas.
- Hazardous waste – pulp mills generate an assortment of hazardous wastes in small quantities, including oily rags, spill collection wastes (chemicals and fuel) and used containers.

A summary of the quantities of waste projected to be generated and the proposed management methods for the Botnia and ENCE mills is presented in Table 4.7-1. A schematic diagram of waste management practices in the proposed pulp mills is presented in Figure 4.7-1. The location of each project's landfill is presented in Figure 4.7-2.

Table 4.7-1: Solid Waste Generation and Management Summary

		Botnia			ENCE	
SOLID WASTE		**QUANTITY**	**MANAGEMENT/DISPOSAL**		**QUANTITY**	**MANAGEMENT/DISPOSAL**
		Tons/year			Tons/year	
Domestic		3,500	Municipal Landfill		2,000	Municipal Landfill
Sludge						
- Raw Water Treatment Sludge		9,000	Industrial Landfill/Future Recycle		1,000	Effluent Treatment/Bark Boiler
- Fiber Sludge (Primary)		6,000	Plantations/Compost		1,200	Bark Boiler
- Biological Sludge (Secondary)		6,000	Recovery Boiler		6,000	Recovery Boiler
Chemical Recovery Process						
- Green Liquor Dregs		30,000	Industrial Landfill/Future Recycle		10,000	Industrial Landfill
- Grits		6,000	Industrial Landfill/Future Recycle		1,000	Industrial Landfill
- Lime Mud		4,000	Industrial Landfill/Future Recycle		1,000	Industrial Landfill
Other						
- Ash from Bark Boiler		-	-		6,500	Industrial Landfill
- Wood Preparation Waste		8,000	Plantations/Compost		4,000	Bark Boiler
- Sand, Stones etc from Wood Handling		-	-		2,000	Industrial Landfill
- Rejects from sand traps		1,000	Plantations/Compost		-	-
Total Solid Waste		73,500			34,700	
Total to Boilers		6,000			12,200	
Total to Plantations/Compost		15,000			-	
Total to Industrial Landfill		49,000			20,500	
Hazardous Waste		100-150	Off-site Disposal Facility per Approved Plan		80-100	Off-site Disposal Facility per Approved Plan

Figure 4.7-1: Schematic Diagram of Waste Management in Pulp Mills

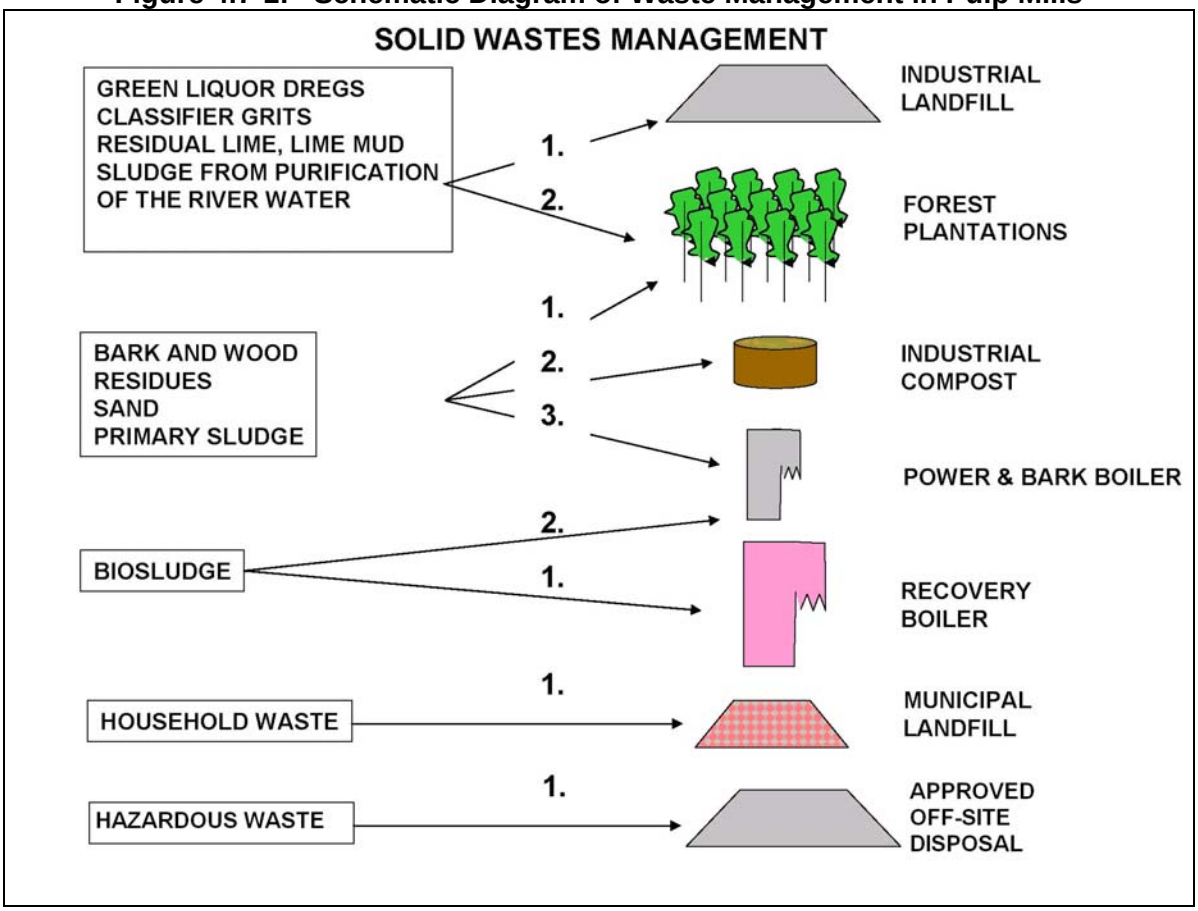
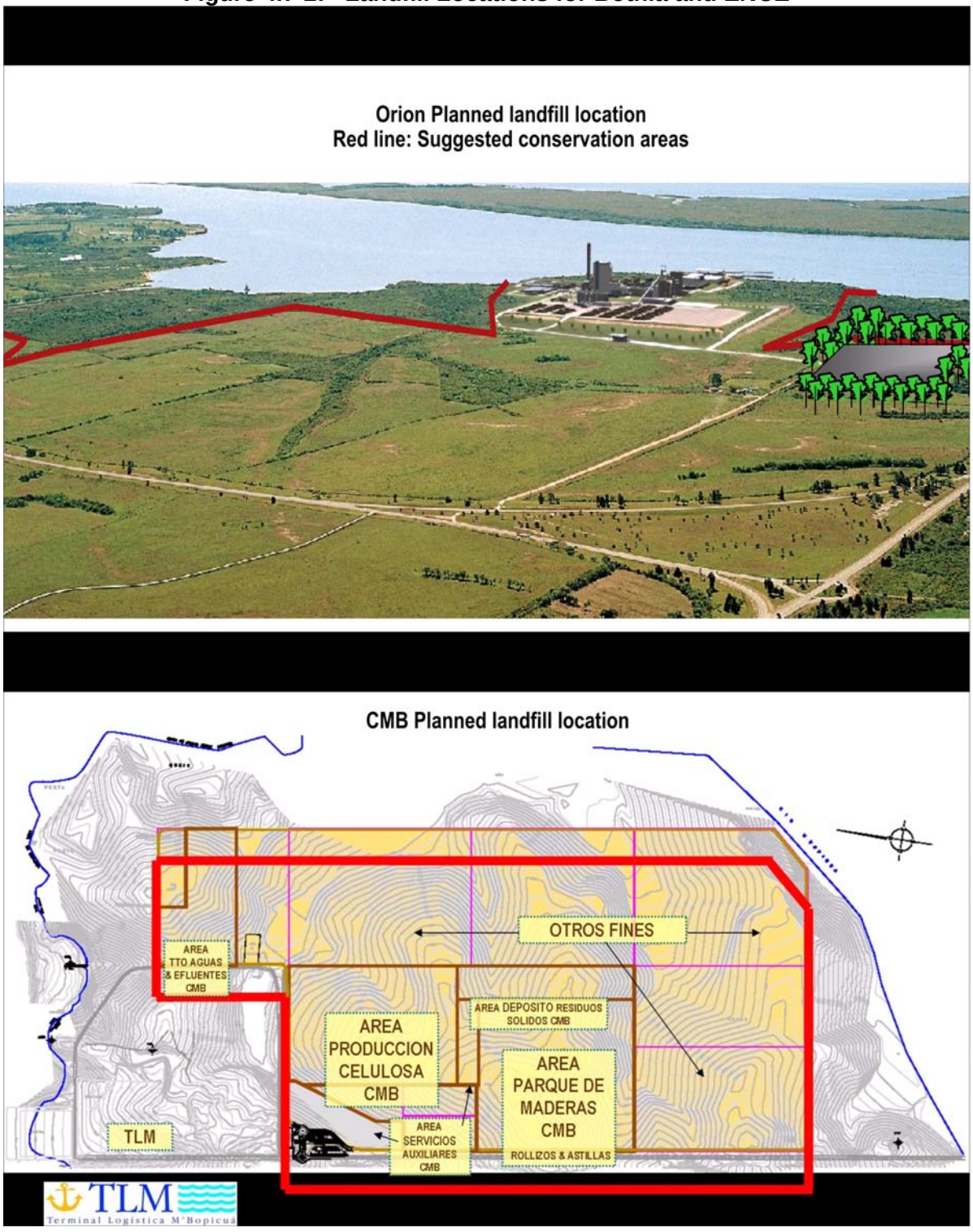


Figure 4.7-2: Landfill Locations for Botnia and ENCE



4.7.1 Landfill Development

Both projects propose to construct on-site landfills for disposal of non-hazardous solid waste. The preliminary basis of design is as follows in Table 4.7-2.

Table 4.7-2: Landfill Design Characteristics of the Botnia and ENCE Pulp Mills

Item	Botnia	ENCE
Shape	3 trapezoids	8 cells initially, 12 cells if expansion required (layout 6 x 2)
Length (m)	400 to 600	750
Width (m)	200 to 210	190
Thickness (m)	8 to 14	8
Surface area (m^2)	110,000	93,250
Volume (m^3)	930,000	560,000
Estimated Capacity[1] (years)	19	30

[1] Landfill capacity will depend on the quantity of waste that is recyclable. Waste diversion programs are expected to extend the life of the landfills.

In general, both landfill designs will consist of: a low permeability soil or geocomposite bentonite liner over the compacted subgrade; an impermeable geomembrane (plastic) liner; and a leachate collection system consisting of high permeability material and perforated plastic piping.

Both landfills will be located on their respective plant sites. This will minimize off-site truck traffic, provide for adequate landfill security and control, and allow collected leachate to be readily transferred to effluent treatment facilities. After the landfills have reached their final grade, they will be covered with a low permeability barrier and soil suitable for revegetation.

In general, organic waste will go to the bark boiler (ENCE), plantations or compost (Botnia). Therefore, the waste in the industrial landfills will be primarily inorganic. The only potential organic waste going to an industrial landfill is the sludge from Botnia's river water treatment system. However, the organic content of the raw water treatment sludge is relatively small compared to the amount of inorganic waste going to the industrial landfill. In addition, the alkaline lime mud, grits and dregs are expected to inhibit biological gas generation. If required, passive landfill gas venting systems can be installed to allow decomposition gases to vent to the atmosphere and avoid potential subsurface migration. Alternatively, these gases could be collected for combustion.

The Botnia landfill will comprise three excavation areas, with three cells per excavation area. The capacity of 19 years for the Botnia landfill is a conservative estimate based on 49,000 m^3 of solid waste being disposed per year (density of 1 ton/m^3 assumed). Botnia expects that part or all of the waste streams going to the landfill at the beginning of the project will later be sent to the plantations to recycle elements as nutrients for the growth of trees. In this way, the lifespan of the landfill will be extended. If required, there is additional space on the property to expand the landfill.

The estimated capacity of 30 years for the ENCE landfill is based on the construction of eight cells and 16,700 m^3 of solid waste being disposed per year (densities between 1.1 to 1.3 ton/m^3 assumed for the various waste streams). The modular design of the landfill enables expansion of the landfill if required. If waste diversion programs (e.g., composting) are successful, then the expansion will not be necessary. If additional space is needed to extend the life of the landfill, four additional cells could be constructed. This would create enough space in the landfill to receive residual wastes for a period of operation greater than 40 years.

4.7.2 Potential Impacts of Non-Hazardous Materials

Landfill installations may produce a number of impacts if they are not properly designed and operated, particularly in relation to leachate contamination. However, both landfill designs are consistent with state-of-the-art practice for these types of non-hazardous waste landfills. The landfills are designed to minimize potential environmental impacts to groundwater or adjacent surface waters.

Both companies will ensure that their facilities are located in areas with suitable geology and soils, and include careful construction techniques and monitoring of the placement of the low permeability soil and geomembrane layer, to avoid potential leachate releases to the environment. The leachate collection systems will divert leachate to their effluent treatment plants. The groundwater monitoring systems will consist of a network of upgradient and downgradient wells to monitor potential impacts and implement corrective actions as appropriate. Each load of waste will be inspected, weighed and recorded to verify waste generation rates and determine if corrective measures are required.

4.7.3 Hazardous Waste Generation

Hazardous wastes generated at the facilities will consist of a variety of materials including but not limited to small quantities of used oils, solvents, detergents/cleaning compounds, certain building and maintenance chemicals, fluorescent light bulbs, and laboratory wastes. Botnia has estimated that 100 to 150 tons of hazardous materials will be generated on an annual basis. For ENCE, an estimated 80 to 100 tons per year of hazardous waste will be generated.

Both projects will transport these wastes to an appropriate off-site hazardous waste management facility. However, at this time, only limited facilities exist in Uruguay for the

management of these types of materials. Botnia has indicated that they would export these materials using appropriate containment to a suitable facility in another country if necessary. Ultimately, the location and management plan for these materials must be submitted and approved by DINAMA. While the quantities of hazardous wastes generated by these facilities is not large compared to other industries, these projects could be used as a basis for Uruguay to develop appropriate management, transport and disposal guidelines, and future in-country facilities.

4.7.4 Potential Impacts of Hazardous Materials

Hazardous materials may produce soil and water contamination if they are not properly handled. Both companies will have to develop adequate plans for the off-site government approved disposal of hazardous wastes. Given that the production of hazardous waste is relatively small and their characteristics are relatively benign, these wastes will be stored in proper containers before being sent to a government-approved disposal site.

4.7.5 Cumulative Impacts

There are no cumulative impacts associated with the management and disposal of solid wastes given that there are no waste sites in this area currently. Solid waste transport and the activities around each landfill are restricted to the plant site. Landfill design and construction are secure in terms of avoiding possible leakages of leachate to the soil or rainfall drainage to the surface waters. No impacts on aquifers, including the Guarani Aquifer, are expected.

No cumulative impacts are expected from the management and disposal of hazardous wastes. Hazardous materials are relatively small in quantity and can be readily handled in basic containment facilities using standard international procedures. These two pulp plants are the first large industrial operations of their type in the country, and their development could stimulate third parties, including the responsible government agencies, as well as the project proponents to start formal planning for this type of broader waste management issue on a regional, national or bi-national basis.

4.8 Social and Economic Aspects

Founded in 1859, the history of Fray Bentos is intertwined with the development of a meat processing plant. The plant, Anglo del Uruguay (Anglo), was originally the called the Liebig Extract of Meat Company and opened in 1866. It was ranked among the largest industrial complexes in South America and played a major role in the development of Uruguay's cattle sector. In 1873 it started to produce "Fray Bentos Corned Beef", a label that quickly became well known in Western Europe. As a result of the economic success of the processed meat in the European market, Fray Bentos became a major centre for innovations in Uruguay. For example, in 1869 the first hydraulic pump in Uruguay was installed at the meat processing plant. In 1873 the first steam-powered plough arrived and,

in 1883 for the first time in the history of the country, electric power was used at the facility. In 1924 the plant was bought by the Vestey group of England and renamed to Anglo.

Fray Bentos experienced a boom to its economy and at its peak the plant employed 5,000 people. As Anglo grew, the infrastructure to support it also grew including the development of a hospital, school, and worker housing. Another legacy of the Anglo 'boom' days is the municipal golf course located between the core urban area and the meat processing site. The golf course supports a club house, two outdoor tennis courts, a squash court and a grounds-keeper cottage.

Due to declining markets and new manufacturing advances in Europe, Anglo ceased its operations in 1971. The Uruguayan government continued to operate the processing plant until its closure in 1979.

Predominately a single-industry town, the closure of the meat processing plant was devastating for the community of Fray Bentos. As conveyed during interviews, it was not unusual for two or even three generations of a family to be employed at Anglo. Closure of the plant left many families without an income; consequently, the community entered into a 'bust' scenario with a reliance on government pensions, out- migration of workers and youth, degradation of infrastructure, and little economic investment in Fray Bentos.

The community of Fray Bentos is very proud of Anglo and their meat processing past. The plant has been converted into a museum depicting the history of the industry. Other support services available include a restaurant and artisan-souvenir shop. The grounds make up part of the public parklands along the Uruguay River where horses and cows are permitted to graze freely.

This history of foreign investment in the community and single-industry reliance has shaped the development and attitudes of Fray Bentos in the last forty years. Interviews with local government and with sociologist professors/professionals provided anecdotal information on the history of Fray Bentos. All referred to Fray Bentos as a community "waiting for something" or an "expectant community". Several attempts were made over the years to attract foreign investment in an attempt to reopen the meat processing plant, or to utilize the property in some sort of tourism capacity. Both attempts failed, leaving the community disappointed. When Botnia and ENCE announced their plans, the community initially reacted with cautious optimism.

4.8.1 Economic Impacts

There is expected to be a significant increase in local employment opportunities – both direct and indirect – during the construction of the two plants and their subsequent operation. As a result, there is likely to be an influx of job seekers into the department of Río Negro. The socio-economic impacts of the two projects have been considered from the perspective of direct and indirect effects on the regional and national economy as well as on social services and quality of life in the vicinity of the two plants. Finally, the impact of

the projects on populations who depend on natural resources for their livelihoods has also been considered.

It is expected that there will be little economic impact to Argentina overall, and this will be further reduced while the conflict over the pulp mills persists. Should conflict recede, it is possible that some wood sales to the pulp mills could result over time as well as other indirect economic activities, associated with the mills presence.

The consultants engaged by Botnia and CMB to examine the macroeconomic impacts of the pulp mills used different methodologies, prices and time periods.[14] The resulting cumulative impacts include some adjustments to reconcile these approaches. The economic impacts discussed below describe three types of effects:

- **Direct Impacts** – activities of the construction sector in building the pulp mills and carrying out all related work;
- **Indirect Impacts** – activities of all other sectors directly related to building the plants and carrying out all related work and providing services to the mills and its employees (e.g., manufacturing, energy, construction, transport, food, lodging, etc.).
- **Induced Impacts** – activities induced by increases in consumption and investment as a result of the construction of the plants (i.e., the multiplier effect of direct or indirect earnings on wider economy).

A detailed evaluation of these impacts during both the construction and operation phases of both plants as well as a description of the methodology used in estimating these values are presented in Annex E - III.

The cumulative impacts of the two projects on the national and regional economy and on employment, as illustrated in Table 4.8-1, are likely to be significant in terms of economic performance, employment, balance of trade and tax revenue.

[14] HCG Environment Consultants , "Socio-Economic Study of the Impacts of the Botnia Pulp Mill Project" (Spanish version May 2004, English translation June 2004); Tea, Deloitte, Touche, "Economic Impact Study of the M'Bopicuá Pulp Mill (CMB)," (November 2003); Tea, Deloitte, Touche, "Update of the Economic Impact Study of the M'Bopicuá Pulp Mill (CMB)" (January 2005); ENCE, "Feasibility Study, M'Bopicuá Pulp Mill Project" (2004); *Handbook of Input-Output Table Compilation and Analysis* (New York: United Nations, 1999).

Table 4.8-1: Cumulative Economic and Employment Impact for the Botnia and ENCE Pulp Mills[15]

Impact	Region	Construction Phase (2005-2007)	Operational Phase (Typical Year)
Economic (USD Millions)	Uruguay	417 (3.2% of 2004 GDP)	331 (2.5% of 2004 GDP)
	Río Negro	206 (112% of 2003 GDP)	223 (121% of 2003 GDP)
	Soriano	33 (14% of 2003 GDP)	13 (6% of 2003 GDP)
	Paysandú	41 (13% of 2003 GDP)	23 (7% of 2003 GDP)
Employment (Person-Years)	Uruguay	18,699 (1.4% of 2004 Total)	12,593 (0.9% of 2004 Total)
	Río Negro	11,196 (109% of labor force)	4,773 (47% of labor force)
	Soriano	1,337 (6% of labor force)	1,108 (5% of labor force)
	Paysandú	2,421 (8% of labor force)	2,048 (7% of labor force)
Balance of Trade (USD Millions)	Uruguay	- 1,100 (Similar to "normal" annual average)	+244 (Approx. 22% of "normal" trade deficit)
	Uruguay	+83 (2% of 2004 revenues)	+39 (1% of 2004 revenues)
	Río Negro	-1.8 (19% of 2004 revenues)	+0.9 (10% of 2004 revenues)

Economic Performance – The economic impact of the two projects will be equivalent in value to about 3.2% of Uruguay's 2004 Gross domestic product (GDP) over the full three years of the construction phase, and about 2.5% of 2004 GDP in each year of full capacity production (approximately 40 years for each plant). The impact on the country's Gross National Product (GNP) is estimated to be 2.8% for the entire three year construction period and 1.5% for the years in which the plants are operating at full capacity. The Department of Río Negro is expected to experience significant impacts, with GDP increasing by an equivalent amount to that in 2003 for the construction phase and for each year of full capacity production during the operational phase. The economic impacts for the neighboring departments of Soriano and Paysandú will still be significant, though of lesser magnitude compared to Río Negro. The estimated combined economic impact from constructing and operating the plants is provided in Table 4.8-2.

The direct, indirect or induced economic impact of the pulp mills on the Argentine border of Río Uruguay was not evaluated.

[15] Summary of economic impact analysis from Annex E-III.

Table 4.8-2: Estimated Economic Contributions during the Construction and Operations Phases of both Pulp Mills (USD millions)

	Construction Phase			Operations Phase		
	Botnia	ENCE	Total	Botnia	ENCE	Total
Direct	86	43	129	107	59	166
Indirect	100	51	151	62	34	96
Induced	60	31	91	35	19	54

Employment – For Uruguay, the employment impacts will also be significant, accounting for an increase in the equivalent of 1.4% of the 2004 national labor force over the three years of the construction phase and equivalent to slightly less than 1% of the 2004 national labor force during each year of full capacity production. As Table 4.8-1 above indicates, the Department of Río Negro is expected to have a significant increase in employment, being equivalent to about 109% of its 2004 labor force over the construction period and 47% of the labor force during each year of full capacity production. The mills are expected to attract labour force entry for those of working age and for those outside the local labour market. Such prospects of increased employment in the department will encourage migration from other parts of the country and day commuters from neighboring departments. The employment impact on Soriano and Paysandú, while not as large as that for Río Negro, will be important as both of these departments have a significant amount of unemployment (16.9 % and 16.2%, respectively). Table 4.8-3 illustrates the estimated employment that will be generated by the construction and operations phases of the two projects. Estimates of employment generated by each company during the construction phase show peak values that occur during the four-year construction period (2005 to 2009). Estimates for employment generated during the operation phase are for one year of full operation.

The mills have an outsourcing of services policy that will be implemented throughout the construction and operation phases as long as it is economically viable and that such suppliers comply with the required international standards of quality. Uruguay does not have the capacity to offer all services required, thus the mills will need to outsource services to other countries. Although Argentina could offer outsourcing services, their refusal to permit construction of the pulp mills makes such services uncertain.

Table 4.8-3: Estimated Employment Generated during the Construction and Operations Phases of both Pulp Mills

	Construction Phase			Operations Phase		
	Botnia	ENCE	Total[1]	Botnia	ENCE	Total
Direct	4,200	5,050	9,250	300	300	600
Indirect	5,710	6,866	12,576	3,976	2,094	6,070
Induced	2,512	3,020	5,532	3,879	2,043	5,922
Total	12,422	14,936	27,358	8,155	4,437	12,592

[1] The total number of workers required for both projects. Some individuals may be expected to work on both projects.

In July 2006, Botnia was employing 2,458 workers for construction, of which 51.5% came from Río Negro, 21% from the Departments of Soriano and Paysandú, and nearly 25% from other Uruguayan departments. Specialized workers from Brazil and Finland accounted for 2.5% of the employees.

Indirect jobs are evident in the beekeeping sector where the effect of increased forested areas extends harvest season (from December-July) resulting in honey production typically not seen during the eucalyptus flowering season. Honey production has been reported to increase by nearly 30%. Although 2005 was an exceptionally dry season, eucalyptus honey accounted for 45% of the revenues.

Landowners are often encouraged by the additional income generated by leasing land for beehives that is in close proximity to the forests. The contribution of cattle-raising in the forested areas is estimated to create 1 job for every 1,000 hectares of forest.

Balance of Trade – During the construction phase there will be a negative effect on the trade balance. This effect will be approximately equivalent to the annual deficit registered during the "normal" years prior to the onset of the Argentine fiscal crisis in 2001-2002 at which time imports fell drastically. However, during the years of full capacity production of the pulp mills, about 22% of the "normal" trade deficit will be offset by the positive trade flow generated by sales of pulp, the less negative trade flows of reduced overseas log sales, and the imported inputs for the pulp mills.

Revenues – Central Government revenues should total the equivalent of about 2% of 2004 revenues for the construction phase. For each year of full capacity production, the pulp mills should contribute slightly less than the equivalent of 1% of 2004 revenues. Incremental expenditures incurred to support the establishment of the pulp mills by the departmental government of Río Negro total about US $1.8 million, equivalent to about 19% of 2004 revenues. When the pulp mills are at full production it is estimated that the

Government of Río Negro will collect approximately US $916,000 annually as additional revenue, equivalent to about 10% of 2004 revenues.

Summary

The construction of the pulp mills in Río Negro will have a positive economic impact in Uruguay, especially in Río Negro, Soriano and Paysandú. There will be an increase in employment during both the construction and operation phases. During the operation phase, most employment opportunities will be generated through indirect and induced employment. Under current circumstances the mills will have a negligible economic impact in Argentina.

4.8.2 Potential Impacts of Labour Influx

The direct social impact in the construction phase of the pulp mill projects will be the influx of persons, primarily to Fray Bentos and its environs, attracted by the opportunities for employment. The actual scope of this influx is difficult to predict for a number of reasons, including the following:

- The extent to which the employed, underemployed or unemployed population living within commuting distance of the proposed projects – including both Uruguayan and Argentine population centers – will seek and obtain employment during construction is unknown;
- The extent to which non-local construction workers will migrate to the area in search of employment is unknown and is, in part, dependent on employment opportunities with the pulp mill construction as well as other construction employment in the greater region;
- The capacity of contractors to provide for, and manage their own labor force will vary from contractor to contractor; and
- The extent to which the sequence of construction at both plant sites overlaps so that construction workers complete tasks at one site and move to the next depends on a wide variety of factors including project financing and manufacturing equipment delivery.

Each project is expected to require 4,000 or more workers during peak construction. Botnia is currently under construction and will hit its peak construction worker period in December 2006, whereas ENCE estimates a start-up date for their construction of mid-February 2007. ENCE anticipates it will reach its peak construction period in June 2008. Thus, as the construction at Botnia winds down, the construction activity at ENCE will gear up. As shown in Figure 2.8-2, the labor requirements for both projects combined will be less than the peak values for the Botnia and ENCE projects individually.

The increase in population during the three to four years required to construct both plants will be heavily weighted towards men, and in particular younger men. Both companies have discussed with community officials ways to mitigate and manage potential impacts from the influx of workers. Concerns related to the influx of workers include increased incidents of drunk driving, increased incidents of drunken public behaviours, increased incidents of sexually transmitted diseases, and pregnancies.

To help manage the number of workers coming to Fray Bentos in search of employment with one or both of the mills, transportation is provided from communities within commuting distance. This will encourage employees to remain in their home communities and not relocate to Fray Bentos.

Anecdotal evidence suggests that the influx of workers will not be long-lived. The experience of large construction projects in Uruguay such as the Salto Dam and the San Martin International Bridge indicates that the migrant workforce disperses from the construction zone, perhaps to other projects in the region, back to their homes or, to some extent integrate into the local population.

Botnia's July 2006 monitoring report indicated that the participation rate for the 20 to 29 age group has increased in Fray Bentos 40% over baseline. An increase in the number of women working was also reported. Nonetheless, an analysis of the regional social profile, especially of the economically active population, indicates that there is an insufficient working age population to meet the labor requirements of plant construction in Fray Bentos and other population centers in the departments of Soriano, Río Negro and Paysandú. Despite the availability of workers, given the negative climate toward the mills in Gualeguaychú, it is not anticipated that workers for the construction phase will originate from there. In addition to the strong peer and social pressure to not seek employment at the mills, daily crossing of the International border and transportation may also prohibit workers from Gualeguaychú in seeking employment.

To meet the construction requirements both skilled and unskilled workers will be recruited from throughout the region, including Brazil. As a result, there will be increased demand on social services to cope with the increase in population, particularly in the areas of housing, health, public safety, education, transport, as well as recreation and cultural activities. The major impact will be on the social services provided in the city of Fray Bentos. The specific impacts will depend on the numbers of local and commuting workers relative to non-local residents that that will occupy the positions created during the three to four years of the construction phase. There will also be associated impacts of population increases associated with ancillary economic activities that develop as the economy of the area grows.

Employment Training – Training of the local workforce for skilled and semi-skilled jobs will be an important means of regulating and managing the impacts of migrant workers. To maximize local employment generation, both companies have established agreements with

the Ministry of Labour and Social Security and the National Employment Board to establish skills training courses to qualified trainees. A welding school was developed with Botnia's support in Fray Bentos, and programs and shops to support welding at high schools within the Uruguay area of influence have been implemented. However, the level of qualification of local workers and trainees as well as the desire for employment will limit the numbers of applicants for jobs during both the construction and operation phases of the projects. The timing and scope of construction schedules will demand additional labour from throughout the region.

Housing – The arrival of non-resident migrant workers will result in a substantial increase in the demand for housing, with the present available supply being quickly occupied and with an overflow into Mercedes and other communities within a daily commuting distance of the plants. Trends already being experienced in Fray Bentos include the increased cost of rental properties, an increase in the number of rental properties available compared to baseline, and an increase in the number of home renovations undertaken to accommodate rental units (Botnia 2006).

To address these impacts, Botnia, in coordination with the Land Management Unit of the Municipality of Río Negro, is constructing low cost housing to accommodate workers unaccompanied by families as well as suitable housing for its higher-level employees. The Land Management Unit of the Municipality of Río Negro is coordinating with the National Directory of Land Use (DINOT), to plan for the expansion of urban areas, taking advantage of those areas, primarily in Fray Bentos, that already have basic services and infrastructure. These housing development projects will revert to the municipality once the construction phase is complete, and workers return to their home communities,

During plant operations, there will likely be a reduction in overall housing demand and a corresponding reduction in the cost of renting. However, for more expensive properties there could be an increase in demand owing to demand by high level operational administrators, technicians and skilled labour involved in the operation of the plants and of new enterprises supplying the pulp plants.

Public Health, Safety and Security – There will be an increase in demand for health services at all levels, particularly in Fray Bentos and its vicinity. Private health care will be needed for the workers in the plants, their families, and for those employed in related activities. An increase in public health services will be required for those who cannot afford private health care; for example for families of workers with low levels of remuneration, itinerant workers and others who might not be able to join the labour market and who have limited financial means.

Both Botnia and ENCE employ health specialists on their staff and have management plans to handle health risks and to prevent industrial accidents. Botnia has an agreement with the Ministry of Public Health (MSP) for 24 hour coverage inside its plants. ENCE has a system to attend emergencies within its construction site. The MSP is working out a

strategy to attend to the increased demand for health care, including additional emergency facilities at the Fray Bentos Hospital, together with equipment to permit rapid diagnosis of serious multiple injuries and arrangements with neighbouring departments for rapid movement of patients. The MSP is putting into effect public health awareness and education campaigns to prevent and monitor any possible adverse health effects during the construction and operation phases of the plants including HIV/AIDS and sexually transmitted disease. Private health cooperatives in the various regional centers are planning a system of mutual cooperation.

Mitigation measures for the operational phase include sustaining and adapting those measures proposed for the construction phase so that they address the necessities of plant operations, e.g., issues of health, preventing industrial accidents, and sustaining the safe and effective movement of people and freight by road.

Both companies have developed plans for coordination with local police to restrict and manage the influx of job-seekers and maintain public order during the construction phase of their plants. Similar arrangements have been made with the Fray Bentos fire brigade to enhance responsiveness to fires and other emergencies.

Education – There will be an increase in the demand for public and private education facilities; the former mostly for the children of construction workers and the itinerant population; the latter for children of technical and management personnel. The amount of educational support required will depend on the characteristics of the incoming population and whether they are accompanied by their families.

Both companies have made arrangements with private educational institutions to provide schooling for the children of plant workers. The demand for private education in the area of influence will not fall with the reduction in employment, but rather is more likely to rise with the influx of more highly educated personnel involved in the operational phase of the plants. This demand will cover pre-school, primary and secondary levels.

Quality of Life – There will likely be changes in the quality of life for the population in the projects' area of influence, and most notably in Fray Bentos and in the surrounding area. The pace of life will increase with the influx of outsiders into the area, there will be an increase in traffic, with its attendant increase in noise, and an increase in tourist and commercial activities. There will be greater demand for and supply of cultural and recreation events and activities. With the increasing population, it can be expected that there will be a rise in incidents of anti-social behaviour and in crime.

The Department of Río Negro is working on a plan to satisfy the demand for increased recreational and cultural activities, taking advantage of local facilities and professionals in the fields of music, theatre and cinema. There is also a plan to reinforce the local police and for the elaboration of a plan to improve the security of the citizenry through the prevention of increases in the crime rate and acts against property and persons. The

companies are implanting strategies for communicating with the public through workshops and talks, enabling the residents of the area to ask questions or articulate their worries with regard to noise or other subjects related to the construction of the plants.

With the influx of population associated with both direct and indirect employment related to the pulp mill projects, there will likely be a temporary increase in the cost of goods and services. This increase will affect local residents living on fixed incomes or below the poverty line. However, local wages are expected to increase for the working population. These inflationary pressures are expected to be short-lived as the impact of the construction "boom" on the local economy passes and prices for goods and services fall.

4.8.3 Impacts on Natural Resource-Based Livelihoods

Tourism, agriculture, fishing and apiculture are the principal natural resource-based activities in the area of the pulp mills. By far, tourism is the most significant and the sector is described in Section 4.9.

The area of influence is predominately engaged in some form of agricultural activity. Activities include growing and selling cash crops (including citrus), meat and milk production, and grazing of livestock. Approximately ¾ of the land use in both Uruguay and Gualeguaychú is dedicated to agricultural activities. Raising cattle for meat and milk production tends to be the main activity in the area of influence; however, wheat, oats, sunflower, rice and soy bean are the main crops harvested.

A net benefit will result during the construction and, to a lesser extent, the operation phase, due to increased demand for agricultural products (milk, meat, vegetables, honey, fruit etc). This increase in demand will benefit both the shop/market owners primarily in Fray Bentos and farmers within the area of influence.

The active river fishing population is estimated at 126 persons in the Uruguayan area of project influence and another 50 persons on the Argentine side of the Río Uruguay. There appears to be an active sport-fishing enterprise on the local waters as well. Like beekeeping, fishing is for many a part-time activity although there are a number of subsistence fishermen who work the waters of the Río Gualeguaychú and Río Uruguay. These numbers may double during the harvest season (April/May) during which fish catches using both active and passive techniques (e.g., weirs, nets and lines) range between 250 kg and 300 kg per day. Most of the fish catch is sold on the local market but some is sold to commercial buyers from outside the area, including Brazil.

The analysis discussed in Annex D on the potential impacts during construction and operation of the mills on water and fishery resources indicates that wastewater discharges will be treated to levels that will have no impact on aquatic life, and will be rapidly diluted to undetectable levels in the river. As a result, the type, abundance and health of the fish within the Río Uruguay in the vicinity of the discharge is not expected to change.

A limited amount of nutrient enrichment of the sediments may be experienced within the immediate vicinity of the diffuser (extending the length of the diffuser and for several tens of metres outward). Within this very small area, the benthic community may change somewhat but only in terms of species type not necessarily abundance. This means that the fish food may change slightly in this extremely small area.

CARU and DINAMA both identified that the fisheries resource is impacted by other activities, such as the Salto Grande dam, and industrial activities in the Río Parana. The Salto Grande dam restricts migratory access to the headwater streams where many species of fish spawn. CARU further identified that the spawning and nursery areas are mainly on the Río Parana. The Río Uruguay at Fray Bentos is mainly a feeding ground for adult fish. This means that any impact identified through monitoring will only be measuring impacts on fish originating from the Río Parana.

There are an estimated 1,904 beekeepers in the Soriano, Río Negro and Paysandú departments and another 700 in the area surrounding Gualeguaychú. A number of beekeepers are organized into cooperatives, which facilitate the marketing and sale of honey. The production of honey is generally complementary to other agricultural activities, including plantation forestry, and is for the majority a part-time activity. Eucalyptus trees flower in July, thus extending the honey collection season by four months. The Paysandú honey cooperative (CALAPIS) indicated that eucalyptus plantations have helped to stabilize the annual production of honey due to the longer collection season.

Honey is exported to European markets by both Uruguay and Argentina. The production of honey in Gualeguaychú is reported to generate US $4 million annually in export earnings. Because of the process controls planned for pulp manufacturing at both plants, air emissions from the plants will be well below concentrations, which are known to have any effect on physiology or behavior of the bees, and as a result there should be no measurable impact on the area's apiculture. Also, there are no known cases where these transient and low levels odors have been picked up and accumulated in the honey. Nor are there known cases, within the European community, as some stakeholders have claimed, where imports of honey produced within the vicinity of pulp mills have been denied.

4.9 Tourism

Tourism is well established in and around the area of the pulp mills. In Uruguay, the riverside beach at Las Cañas in the Department of Río Negro, and hot springs to the north of the Department of Paysandú attracted more than 80,000 visitors in 2004 during the peak summer months of January to March. Sports activities and cultural tourism in both Fray Bentos and Mercedes also attract many visitors but they are significantly less popular than the above areas.

Approximately 80% of the tourists visiting Río Negro, Soriano and Paysandú departments originate in Argentina according to the Directorate of Tourism of the IMRN, particularly from

the federal capital and the greater Buenos Aires area. The majority of tourists make their main destination Las Cañas on the Río Uruguay to enjoy sunbathing and water sports. This destination is visited mostly in the summer, but it is also popular during Argentina's national holidays, and long weekends.

The number of jobs directly associated to tourism is difficult to estimate, as insufficient information is available on the number of people employed directly as a result of tourism activities. The Río Negro Director of Tourism suggests that in the commerce, hotel, restaurant and transport sectors, about 150 full time jobs would be attributable to tourism and that during January and February an additional 600 jobs, most of which are related to activities in Las Cañas, are created to serve the heavy influx of visitors during the summer months.

The direct contribution of tourism to the economy of Río Negro, both in terms of the commerce, hotel and restaurant sector; and of the total GDP, for the years 2000-2003, is provided in Table 4.9-1.

Table 4.9-1: Contribution of Tourism in Fray Bentos/Las Cañas to Gross Departmental Domestic Product (GDDP) 2000 to 2003 in US$ Millions

	2000	2001	2002	2003
Expenditure- International Visitors	22.9	20.9	9.5	8.6
Expenditure- Uruguayan visitors	**7.6**	**7.0**	**3.2**	**2.9**
Total Visitor Expenditure	30.5	27.9	12.7	11.5
GDDP Commerce, Hotels & Restaurants (CHR)	33.7	30.3	18.5	16.6
Gross Departmental Product	256.2	256.7	185.7	184.0
Tourism Value Added CHR Sector	16.9	15.2	7.0	5.7
Tourism value added GDDP	**18.9**	**17.3**	**7.9**	**7.1**
Visitor value added as % of CHR Value Added	**36.4**	**36.3**	**27.5**	**25.0**
Visitor value added as % of GDDP	**3.0**	**2.7**	**1.7**	**1.6**

Source: Smith, Peter. Tourism Assessment of Gualeguaychú in the Province of Entre Ríos, Argentina and Fray Bentos in the Department of Río Negro, Uruguay. April, 2006

Gualeguaychú in Argentina is also an important center of tourist activity, particularly in the summer months of January, February and the first half of March. The main tourist attraction is the Carnival (in 2005 164,376 adult tickets were reported to have been sold), which supports approximately 1,500 families (Secretariat of Tourism of the Municipality). The majority of tourists originate from within Argentina (Buenos Aires area) and neighbouring countries such as Paraguay and Chile.

Table 4.9-2 summarizes the expenditure per visit and per day. The devastating effect of the River Plate Crisis of 2002 on Carnival revenues can be seen, when revenues in real terms in 2002 were only one third of the revenue of the previous year.

Table 4.9-2: Expenditures by Carnival Visitors – 2000 to 2005

	2000	2001	2002	2003	2004	2005
Expenditure per visitor (US$)	118.33	113.15	47.46	36.64	57.74	59.73
Daily expenditure per visitor (US$)	43.65	56.81	17.81	15.72	19.59	18.49
Total Expenditure (US$ millions)	16.625	13.160	4.344	4.608	7.775	9.206

Source: Smith, Peter. Tourism Assessment of Gualeguaychú in the Province of Entre Ríos, Argentina and Fray Bentos in the Department of Río Negro, Uruguay. April, 2006

The Carnival complements the water sports and camping activities of weekend visitors and vacationers who largely originate in the Buenos Aires area. There are 12 beach camping grounds in the Gualeguaychú department. The majority of these are on the Gualeguaychú River, but the most popular and largest area is Ñandubaysal on the Río Uruguay. During its peak season approximately 350 people work at the beach resort and it is visited by 160,000 tourists annually.

In recent years, the Municipality of Gualeguaychú has begun to explore opportunities to increase and maintain tourist visits year-round, including further investment in thermal spas, an automobile race track, a convention center, a thematic casino (during Carnival), nautical clubs, and protected natural areas.

There are several ways in which any industrial establishment (such as a pulp mill) could potentially affect the tourism sector in its area. These include:

- pollution of air and water during regular operation and during accidents, which negatively affects the environment within which tourist activities take place;
- effects of associated industrial facilities and activities (e.g., road, river and port traffic), which may be negative;
- visual effects, which distract from enjoyment of other tourist activities;
- negative press resulting from controversy associated with an industrial establishment that discourages tourist visits;
- direct positive impacts through actions of the industry to support development and operation of tourism and recreation infrastructure, sites or events, as part of its corporate role in the community; and
- indirect positive impacts of the presence of the industry, which contributes to general economic development in the area and may lead to an increase in the number and quality of facilities such as restaurants and accommodation, which also serve tourists.

These potential impacts have been considered in the EIAs for the two pulp mills, particularly for Botnia's mill which is closest to Fray Bentos and within view of the main beach area of Ñandubaysal on the Argentine side of the Río Uruguay. In addition, these impacts were assessed for this CIS. These are reviewed below, with particular attention to the existence of any cumulative impacts of the two plants.

4.9.1 Direct Pollution Impacts

Computer modeling of air emissions carried out for the individual environmental impact assessments and for this cumulative impact study, indicates that there will be no significant impacts to air quality in the region. Odour is the main air quality parameter of concern with regard to tourism. Both mills have included advanced technology to capture and eliminate these odours.

Odour will not likely be detectable under normal operating conditions on or immediately adjacent to the mill properties, at Fray Bentos, or the International Bridge (Uruguay and Argentina sides). Odour may be detected under upset conditions at Fray Bentos and the International Bridge (Uruguay and Argentina sides); however, fewer than ten detection events are expected per year based on operating experience at other modern mills, and only a few of these may be considered objectionable by someone with a sensitive sense of smell. The detection of odour does not represent a health concern since the 24-hour concentration of TRS is well below the WHO criteria, although, people on or near the site may notice a sewer type smell or, on occasion, a stronger unpleasant smell. During the first year of operation, it is possible that the NCG system may vent to the atmosphere on occasion for minutes to possibly hours at a time until the collection system is fully functional, after which venting will be limited to a few seconds to minutes in duration

Odour will not be detectable at tourism areas of Las Cañas (Uruguay) or Ñandubaysal Resort (Argentina) under normal operating conditions, but during upset conditions and times of poor air dispersion, the odour effect level is predicted to be above the detection threshold for a person with a sensitive sense of smell. This means that during an upset someone at the beach resorts may detect an odour similar to that experienced in daily life (such as garbage, a poorly tuned car, a sewer) but may not be able to characterize its source. This occurrence is most likely during pre-dawn when air dispersion is poor, and may occur up to ten times per year based on operational experience at modern mills.

Based on the results of the air quality analysis (Annex C) there should be no significant impact on tourism in these areas from odour, cumulative or otherwise.

Wastewater from the two plants is treated to levels at which it poses no direct threat to aquatic life or recreational use of the river, and it is further diluted to undetectable levels within a short distance of the point of discharge. More detailed computer modeling, performed for this cumulative impact study, confirms the rapid dilution of the treated waste

to undetectable levels, and this is true when both outfalls are considered together as well as separately.

Botnia has proposed providing treatment for the Fray Bentos municipal sewage effluent in its wastewater treatment plant. This would result in more complete treatment of municipal wastes, along with eliminating the present downstream discharge that currently impacts water quality in the Las Cañas area. If this proposal is implemented, Fray Bentos would benefit from an enhanced public service and improved water quality downstream of the town, thus improving the water quality of the Las Cañas area.

The event of a serious industrial accident at either or both plants during operation is highly unlikely as appropriate measures have been taken to prevent spills of chemical products, fires, contaminating emissions, etc. Because the plants are designed with the most advanced technologies, they do not include storage of large quantities of hazardous chemicals that would be a threat to the environment if there were an industrial accident. The worst case scenario for an industrial accident at the pulp mill would be an explosion of the recovery boiler. Its harmful consequences would be limited, like any boiler accident, to within a few dozen meters of the boiler – in other words, within the project site – and would result in an immediate shutdown of the plant until the recovery boiler could be rebuilt.

4.9.2 Associated Impacts

Related facilities and activities of the plants were also reviewed for their potential cumulative impacts on tourism. Truck transport (mostly of logs) in the plantation areas and on the national highways leading to both plants is expected to increase approximately 30%. This increase in truck traffic is still within the capacity of the highway infrastructure (Botnia, 2006). This will result in some cumulative impacts of traffic congestion at some intersections, and to the extent that this happens in the Fray Bentos area it may have some impact on tourist traffic in this area. This cumulative impact is considered to be low and relatively localized.

Barge traffic on the river will increase somewhat from present volumes with the operations of the plants. Currently roundwood and wood chips are shipped down river. Roundwood and chip exports will be replaced by pulp and returning vessels will transport chemicals and other raw materials used in the pulping process. This change is not predicted to have any cumulative impact on tourism.

The increase in forest plantation area is discussed further in Section 4.2 of this report. This is not expected to have any negative impact on tourism, and in the longer term may increase the attractiveness of the area as habitat diversity increases and the nature reserves established by the two projects become recognized tourist sites.

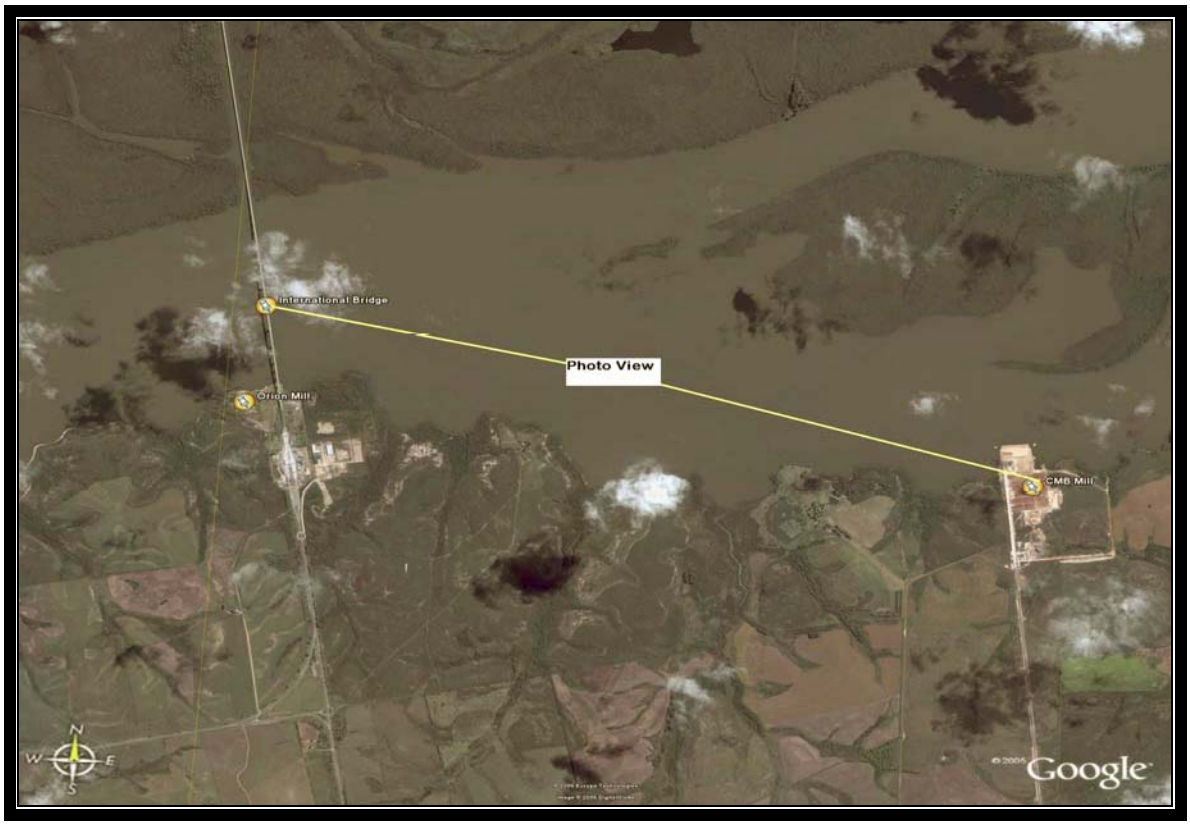
4.9.3 Visual Impacts

The Botnia plant will be a visible new feature in the landscape, especially for tourists crossing the international bridge en route to Las Cañas and other tourist destinations in Uruguay. The ENCE plant will also be visible from the bridge, but further away and less of a visual presence. The change to the landscape is a permanent impact; however, the public's response to these new industrial features is subjective and may potentially change over time as the public becomes accustomed to the new landscape. It is unlikely, that the sight of the plants will discourage tourists from continuing on to Fray Bentos, Las Cañas or other locations in the region.

Figures 4.9-1 to 4.9-2 show the view from approximately half-way across and, at the highest point, of the International Bridge.

Figure 4.9-1: View from High Point of the International Bridge Looking Towards the BOTNIA Mill

Figure 4.9-2: View from High Point of the International Bridge Looking Towards the ENCE Mill



In Argentina, the Botnia mill is the closest and comparatively most visible mill site, located 13 km across and upriver from the beach resort of Ñandubaysal. Although it is new to the landscape, its visible physical presence is far enough away as to be unlikely to cause loss of enjoyment of the beach area for all but the most sensitive users from a visual standpoint. During peak season, January and February, at Ñandubaysal, the river is used for water sports (jet skis, sailing, board sailing, boating, etc). Due to the heavy use of the river for water sports, the Botnia mill will be less noticeable due to these activities on the river; however, the visual impact of the mill will be heightened for those out boating on the river. There is no visible plume from the stacks in modern pulp mills, except for a white steam plume in cold, humid weather.

At night, looking across the river, lights from the Botnia mill will be visible at the beach. Due to the distance and the mills proximity to other existing light sources, namely the International Bridge and the community of Fray Bentos, the impact of lights to people strolling along the Ñandubaysal beach is considered low and is not anticipated to impact significantly on their experience.

Case studies in British Columbia, Canada have shown that tourism can co-exist with pulp mills, as tourism is significant in or near almost all towns or communities with pulp mills in them or within close proximity. The mills have odour control systems that comply with Canadian regulations, but are neither as complete, nor as well backed-up as those proposed for the Fray Bentos mills. In one case study at Prince George, the mills use the ASB effluent treatment process, which is well known to release substantially more malodorous gasses than the AST process, proposed by ENCE and Botnia. At a second mill site in Kamloops, an ECF bleaching process is used with odour control systems; however, these environmental protection systems are neither as advanced, nor as efficient as those proposed for the Fray Bentos mills. In both Prince George and Kamloops, tourism is dependent on outdoor activities such as hiking, canoeing or fishing.

Adverse Social Climate

The beginning of the construction works generated an increased feeling of vulnerability and distress concerning the potential negative effects of the mills for the residents of Gualeguaychú. During this period, the conflict between Argentina and Uruguay escalated generating a negative impact. Posters, banners, pins and scarves sprang up in public places in Gualeguaychú and residents blockaded the International Bridge between Argentina and Uruguay during the 2005 summer months with a recurrence possible in 2006. This opposition to the installation of the mills by the citizens of Gualeguaychú could reduce the possibility for continued growth in the number of Argentine tourists visiting Uruguay. In addition, sustained opposition and the associated negative information campaign may harm tourism in both Uruguay and Entre Ríos, including Gualeguaychú.

4.9.4 Indirect Positive Impacts

Through their presence in the area, the pulp mills will indirectly lead to further economic development. According to the Economic Impact Assessment (Annex E, III) it is estimated that the combined economic impact from operating the plants at full output will be about US $331 million per year. Of this, over 50 per cent will be direct impact of plant production and indirect and induced impacts should account for about 30 and 20 per cent, respectively. To put this in perspective the GDP in 2004 is estimated to be about US $13.2 billion. The economic impact from the operational phase of the mills would therefore represent about 2.5 per cent of 2004 GDP.

Botnia's July 2006 monitoring report has already documented positive indirect economic impacts including an improved investment climate. Within Fray Bentos new businesses have opened such as Avis-Rent-A-Car, and the Great Montevideo Store, Hotel Fray Bentos is under extensive renovations as a result of approximately $1.25 million dollar investment, and two new truck repair shops have opened.

Other economic development can be expected in support services and facilities such as restaurants, hotels, and related facilities which also serve tourists and further contribute to making the area a more attractive tourist destination.

4.9.5 Mitigation

Mitigation measures for cumulative impacts during the operational phase include management of air emissions and water discharges, and emergency preparedness and response, which both companies have already included in their respective action plans. A sustained public consultation and communication campaign will also be necessary to dispel unsubstantiated fears and concerns from the public. This is particularly important to protect the tourism industry.

To provide support to this important sector, the Directorate of Tourism of the Department of Río Negro is looking at ways to expand the availability of tourist sites in the area, for example by promoting a 'forest route' that includes a visit to eucalyptus plantations and the pulp mills.

There is little that can be done to mitigate the visual intrusion of the stacks at the mills. The properties can be landscaped to decrease the overall view of the sites and care should be given to the placement and direction of lighting, as proper shielding of lights can help make the plants less intrusive.

4.10 Transportation

The transportation network in western Uruguay will be affected by the construction and operation of the Botnia and ENCE pulp mills (see Figure 4.10-1). The two most important flows of traffic will be wood and other supplies delivered to the mills, and pulp exported from

the mills. In addition, there will be transport of personnel to and from the mills, and transport of domestic and hazardous waste to appropriate landfills. This section is based on the transportation study (see Annex F) from the draft CIS prepared by PCI Americas and Malcolm Pirnie.

The main modes of transport will be truck, barge or ship for wood and other supplies, and barge or ship for pulp. If the rail system is upgraded, transport of wood and pulp by rail will be an alternative form of transport. Pulp produced by the Botnia mill will be transported by barge to Nueva Palmira for trans-shipment. Because of operating depth restrictions at ENCE's M'Bopicuá port, transport of pulp by truck or barge to other loading points would be required. Currently, the procedure for wood chip exports from the M'Bopicuá port is to load the ocean-going vessels approximately 50%, and top-off in Montevideo where ENCE has built an additional wood chipping plant.

4.10.1 Cumulative Impacts on the Río Uruguay

Table 4.10-1 presents the estimated increase in river traffic expected as a result of pulp mill operations. This projected increase represents only an additional 34% in traffic volume (i.e., around 650 vessels per year) over current rates because the wood chip cargo currently being barged downstream from Terminal Logistica M'Bopicuá (TLM) and Fray Bentos to Nueva Palmira and Montevideo will be replaced by pulp.

To export its pulp production, the Botnia mill will require 333 barges per year, each carrying 3,000 tons per barge, or an average of one round trip barge voyage per day increase to current traffic levels of 5.3 barges per day. Botnia estimates 150 barge trips per year will be required to deliver chemicals and raw materials to the plant. Barges delivering pulp to the Nueva Palmira port will be utilized to transport chemicals and raw materials back to the Botnia mill.

The ENCE mill will maintain ocean-going vessels from the M'Bopicuá port for export of pulp. Currently, these 50,000 ton capacity vessels are being used for export of wood chips to Nueva Palmira and into the Río de la Plata. ENCE plans to partially load vessels at M'Bopicuá and top-off in Montevideo. This process will not generate a significant amount of additional large ship traffic in the river from M'Bopicuá to Nueva Palmira. The balance of ENCE pulp would have to be moved from ENCE to Montevideo, by barge, truck or rail (if the rail system is renovated and upgraded). If 3,000 ton barges are used, ENCE would require 83 barges per year.

ENCE may utilize large vessels returning for pulp loading to deliver these supplies but a conservative estimate of 70 additional barges per year has been made for the purpose of river traffic projections.

Thus, the operations of the two mills could result in a maximum of 650 additional barge trips per year on the Río Uruguay up to M'Bopicuá. This level of traffic would add an additional 1.8 barge trips per day to the existing 5.3 trips per day.

The above analysis suggests that the increase in river traffic when compared to current traffic in 2004 will not be significant because the pulp export traffic will replace the current logs and wood chip volumes being exported or moved in river transport. Therefore, the incremental increase will be less than the total volume of ships and barges required for the export of the pulp produced. Similar to the road traffic analysis, if the two pulp mills were not built (the "no project" alternative) then the logs and wood chip exports in the near future would continue increasing, also requiring more ships and barge traffic to occur in the river.

4.10.2 Cumulative Impact on Road Network

The road network in the project area of influence will be affected during both the construction and operation of the mills. Based on the estimated project timelines between the start of 2007 and mid-2009, the construction activities of both plants overlap and cumulative impacts on the road network during construction could occur. However, since the construction for the Botnia mill will be winding down as construction for the ENCE mill would be gearing up, the cumulative impacts may not be as dramatic as first expected. The impacts during the construction period that will be greatest in the immediate vicinity of each mill include: potential increase in road accidents, an increase in vehicular emissions, and increased demands for road maintenance. Both companies are developing management plans for road transportation in collaboration with the administration of the department of Río Negro.

The approximate cumulative impact of truck traffic on the local road network resulting from the operation of both the Botnia and ENCE mills is summarized in Table 4.10-2. At full capacity of 1.0 million tons per year of pulp production, the Botnia mill will require 3.5 million m^3 of pulpwood per year.[16] The estimated annual average daily traffic (AADT) for the delivery of round wood to the Botnia mill is approximately 512, based on 256 daily return trips by truck on an annual basis between the mill and the surrounding forest plantations. The ENCE mill at full capacity will consume 1.7 million m^3 per year requiring approximately 137 return trips by truck per day, or an AADT of 274.

These numbers imply a significant increase in truck traffic particularly on Highway 2 between the access road to the ENCE mill and the junction with the international bridge (see Figure 4.10-1). There is a potential for congestion in this area, particularly at intersections. Even in the absence of the pulp mill projects, there is still expected to be increased traffic in the area due to potential increases in transport of wood as well as other agricultural commodities. With the Botnia mill in place, wood transport to the port of Fray Bentos will be replaced by transport to the mill, and this will result in a significant decrease in truck traffic in the city itself. According to the transportation study attached as Annex F, the AADT for pulpwood trucks required for operation of the two mills will be 580 on the segment of Route 24 south of Paysandú to the intersection of Route 2. For the segment of

[16] The number of trucks required will vary depending on the species mix for a mill. ENCE uses a higher percentage of *E. globulus globulus* and bark is left on, resulting in less volume per truck.

Route 2 between Mercedes and the intersection of Route 24, the AADT is 206, based on estimated truck traffic for supplying wood to the Botnia and ENCE mills.

These numbers indicate that truck traffic will significantly increase on the road network of western Uruguay that serves the two mills. This increase will be particularly evident on Route 2 between the junction of Route 24 and the access road to M'Bopicúa and the ENCE mill, where there is potential for major traffic congestion. Even in the absence of the two mills, existing truck traffic volumes are expected to double, at least on Route 24, with the continued growth of round wood and agricultural commodity exports via M'Bopicúa, Fray Bentos port and Nueva Palmira. The existing round wood transport to the port of Fray Bentos will be largely diverted directly to the mill site and, thus, bypass the city.

In addition to the potential for traffic congestion which will require traffic control and engineering solutions, the assessment of potential cumulative impacts of increased traffic as well as possible mitigating measures, include:

- Safety: The increase in truck traffic will require measures to control risks to pedestrians, including school children living in communities that are typically located along rural roads in Uruguay. Driver training and dispatch controls can be utilized to maintain road safety.

- Accidents: The current and projected traffic volumes are relatively low because the transport network serves an area of low population density. Impact of the increase in truck traffic and traffic congestion will be minimized with dispatch systems that keep the trucks adequately spaced and also control speeds.

- Air Pollution: The forecast traffic volumes are relatively low for two-lane roads, but with controlled spacing and continuously moving traffic any increase in air pollution should be minimal.

- Increase in Road Maintenance: The increase in truck traffic on the area's road network will require more frequent maintenance resulting in increased costs to the affected department governments. Compensation methods to increase maintenance funding could be developed to charge users for the increased costs, by installing tolls with appropriate rates for log haulers.

Figure 4.10-1: Transport Network Map

Table 4.10-1: Current and Projected Increase of Vessels on Río Uruguay

Vessel Type	Traffic in 2004	Projected Traffic Increase
Ocean going vessels navigating Río Uruguay	240 per year	No significant increase
Barges	1,925 per year	
Barges importing raw materials to pulp mills	-	220 per year
Barges exporting pulp to Nueva Palmira & Montevideo	-	420 per year

Table 4.10-2: Cumulative Impact of Pulp Mill Operations on Local Road Network (daily truck traffic)

Segment of Highway	Current Traffic	Estimated Traffic for Botnia Mill	Estimated Traffic for ENCE Mill	Estimated Traffic for Both Mills
Route 24 from Paysandú to Junction of Route 2	98	420	160	580
Route 2 from Mercedes to Junction of Route 24	245	92	114	206
Total	343	512	274	786

4.11 Energy

4.11.1 Energy Production and Use at the Mills

Most of the wood by-products that are not converted to marketable pulp fiber are burned in the pulp mills to produce energy. The burning of black liquor[17] in recovery boilers at both mills will produce steam and electricity and enable the recovery of cooking chemicals. A biomass boiler at the ENCE mill will produce energy by burning bark and wood waste from

[17] Black liquor is a mixture of dissolved organic substances (lignin) and chemicals (for cooking wood chips).

wood preparation and primary sludge from the effluent treatment system. Energy issues related to the comparison of mill technology with BAT are discussed in Annex A.

Both mills will be connected to the national electricity grid (150 kV and 30 kV lines) and are expected to produce surplus power. The estimated surplus of power to be sold to the national grid is 15 MW for Botnia and 31 MW for ENCE under normal operation. Electricity from the national grid will be used during start-up of production, regular maintenance and unplanned shutdowns (about 15 days per year). Fuel oil will be required for the boilers (for start-up, shutdown and unbalanced conditions), the lime kiln, the incinerator of odourous gases, and for emergency power.

Analysis of environmental permit applications by DINAMA considers the mills and chemical plants as typical industrial installations, with the Kemira plant being part of the Botnia mill, and there is no reason to modify this approach. However, when examining the combined impact of the mill projects, it is useful to consider the beneficial impact on the overall electric power balance of Uruguay.

Any energy balance must be based on a defined boundary. In the pulp industry, it is normal practice to consider the mill fence, and ignore electricity consumed to supply chemicals to the mills. In this case, production of chemicals for the mills within the boundary is included in the assessment. This approach differs from the surplus power estimates provided in Annex A but is considered appropriate for the purposes of this energy assessment.

The Botnia mill is expected to produce approximately 47 MW of excess power, of which the Kemira chemicals plant requires 12 MW to produce chemicals for Botnia's mill (net surplus of 15 MW). The ENCE mill is expected to produce a surplus of around 31 MW. The manufacture of chemicals to supply the ENCE mill will consume around 6 MW, therefore the net export for ENCE will be approximately 25 MW.

The Kemira plant will require approximately 40 MW to operate at full capacity when chemicals are produced for third parties. By using electrical energy from the Botnia mill, Kemira will avoid drawing an equivalent amount from the national electrical grid. Any export of chemicals from the Kemira plant beyond Fray Bentos to existing mills will be based on power generated from biomass and may replace fossil fuel generated electricity elsewhere. Analysis of the environmental benefits of this versus possible future energy consumption is beyond the scope of this CIS.

Based on Botnia's expected surplus of 15 MW and ENCE's expected surplus of 31 MW, a total of 46 MW could be sold to the grid when both mills are in operation. This should represent a significant economic and environmental opportunity to Uruguay. The power contribution by the mills should reduce Uruguayan oil imports and the air pollution from burning the oil power stations. These projects are in accordance with recent documents issued by the Energy Ministry about Uruguayan Energy Policy, which is clearly in the direction of promoting renewable private generation.

4.11.2 Electricity Production and Demand in Uruguay

Uruguay's annual electricity generation is approximately 9,000 GWh based on data from 2000 to 2005. Uruguay's hydroelectric plants are able to meet most of the country's electricity demand. On average, 83% of Uruguay's electricity was generated by hydroelectric plants over the 2000 to 2005 period. Since power production from the hydroelectric plants fluctuates due to weather conditions (i.e., lack of rain), the country relies on imported electricity from Argentina and Brazil, and thermal power plants (oil and diesel) to meet demand during shortfalls. Hydroelectric generation is reaching full capacity, therefore Uruguay has been seeking to diversify its energy supply (e.g., wind power, natural gas) to meet increasing demand in the future.

In June 1997, Uruguay changed its electricity laws to allow independent power producers to generate power. An association of independent power generators was established recently. The electricity sold by the pulp mills to the national grid can be called green power because it is produced using biomass[18] which is a renewable resource. Since carbon dioxide is captured through photosynthesis, the use of biomass to produce energy is considered carbon neutral (i.e., no net increase in carbon dioxide emissions to the atmosphere).

4.11.3 Potential Impact of Selling Electricity to the National Grid

The power sold by the mills to the national electricity grid can be considered to have a positive impact if it offsets environmental impacts associated with production of electricity by thermal power plants. Like most systems in the world, low-cost energy sources such as hydro power are used to the maximum in Uruguay, and the shortfall is made up with oil or other fossil fuel generation. Thus, any input of "green" power from the pulp mills will result in an equivalent reduction of fossil fuel use somewhere, whether in Uruguay, Brazil or Argentina. If there is actually more hydro power available than the total demand, which is conceivable for short periods, the hydro dams will store water for future use, or hydro power can be sold to Brazil or Argentina and offset fossil fuel use there.

An approximate comparison can be made of the estimated fuel oil consumption for processes at the Botnia mill relative to the electrical energy surplus that may be supplied to the national grid and is presented in Table 4.11-1.

To estimate the amount of fuel oil required to produce the amount of electricity sold to the electricity grid, an efficiency of 27.5% was assumed. This is typical for thermal plants in Uruguay. Efficiency is the amount of power produced per amount of fuel burned. This means that the amount of energy produced as electricity would be equal to 27.5% of the energy contained in the fossil fuel feed. Based on the calculations shown in Table 4.11-1,

[18] Biomass is organic matter (e.g., wood material, vegetation, agricultural waste) used as fuel.

the amount of surplus energy that may be sold to the national electricity grid is equivalent to more than the amount of energy consumed as fuel oil at the Botnia mill.

The fact that the energy needs of the mills are supplied primarily by black liquor and wood waste is an advantage compared to other industries that are not based on renewable energy sources. The estimated emissions associated with the production of 500 GWh of electricity are shown in Table 4.11-2. The potential emissions from thermal power plants corresponding to the surplus electricity from the pulp mills are based on the National Greenhouse Gas Inventory for 2002 (Inventario Nacional de Emisiones Netas de Gases de Efecto Invernadero, INGEI).

4.11.4 Potential Impact of Collecting and Burning Wood Waste from the Surrounding Area

A biomass boiler at the ENCE mill will burn bark and wood waste (fines) from wood preparation and primary sludge from the effluent treatment system. Wood waste from other sources, such as sawmills, may also be collected and burned in the biomass boiler at the ENCE mill. The bubbling fluidized bed boiler, equipped with electrostatic precipitators to be used at the ENCE mill would discharge a trivial amount of atmospheric pollutants relative to burning equivalent quantities of wood waste in the older incinerators in common use in sawmills.

The collection and burning of wood waste to generate electricity would therefore virtually eliminate the environmental impacts associated with incineration of wood waste in low-technology burners or decomposition of wood waste in landfills. However, the impacts cannot be quantified in this report because the suppliers of wood waste and their practices regarding wood waste have not been analyzed at this time.

The supply of wood waste from outside sources will depend on transportation costs, distance to potential suppliers, and wood waste prices at the moment of purchase. In Uruguay, there are around 200 sawmills. Within a radius of 200 km of Fray Bentos, there are six sawmills. In general, wood waste from small sawmills is burned for domestic heating, wood drying, and brick-making, or simply left to decompose at disposal sites. Some larger sawmills sell some of their wood waste as chips for pulp production in Uruguay or export them to Argentina and Europe. The magnitude of the positive impact of burning wood waste from outside the ENCE site will depend on the supply of wood waste for the ENCE mill and the way that the wood waste was previously managed.

Table 4.11-1: Comparison of Fuel Oil Consumption and Electricity Surplus for the Botnia Mill

Mill Process	Type of Fossil Fuel	Fossil Fuel Consumption (ton/year)	Conversion Factor (ton of oil equivalent/ton)	Fossil Fuel Consumption (ton of oil equivalent/year)
Odourous gas incinerator	light fuel oil	1,200	0.9056	1,100
Recovery boiler	heavy fuel oil	20,000	0.9590	19,200
Lime kiln	heavy fuel oil	37,000	0.9590	35,500
			Total	**55,800**
	Energy to Grid (GWh/year)	Conversion Factor (ton of oil equivalent/GWh)	Fossil Fuel Equivalent (ton of oil equivalent/year)	Fossil Fuel Consumption to Produce Electricity[1] (ton of oil equivalent/year)
Electricity surplus (35 MW)	294	260	76,440	**278,000**

[1] An efficiency of 27.5% was assumed for electricity generation using fossil fuels.

Table 4.11-2: Estimate of Potential Offset of Emissions from Thermal Power Plants for Electricity Generation of 500 GWh

Parameter	Estimated Emissions from Thermal Power Plants for Electricity Generation of 500 GWh (tons per year)
Carbon dioxide (CO_2)	495,107
Methane (CH_4)	20
Nitrous oxide (N_2O)	5
Nitrogen oxides (NO_x)	1,308
Carbon monoxide (CO)	99
Non-methane volatile organic compounds (NMVOCs)	33
Sulfur dioxide (SO_2)	7,354

[1] Emission rates were calculated using the estimated emissions for 2002 (INGEI 2002) reported as part of Uruguay's commitment to the United Nations Framework Convention on Climate Change (Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, Direccion Nacional de Medio Ambiente, Unidad de Cambio Climatico, Mayo 2004).
[2] An efficiency of 27.5% was assumed for electricity generation using fossil fuels.

4.12 Regional Developmental Impacts

The proposed pulp mills will continue the development of the forestry sector in the region as planned and supported at least since the mid-1980s. Multi-lateral donors assisted with studies and financing; the government of Uruguay agreed to pro-actively pursue such a development pathway in an environmentally and socially acceptable manner. Construction and operation of the proposed pulp mills will bring increased value-added benefits (both direct and indirect) to the local, regional and national economies rather than exporting them to overseas jurisdictions.

4.12.1 Community Development

ENCE and Botnia have made significant and ongoing commitments to programs and activities that will result in community development benefits to their local and regional communities. Each company has developed Social and Environmental Action Plans that describe in detail this commitment. Overall, the cumulative impact of these programs are expected to be positive and bring long term benefits to the local and regional communities.

The Department of Río Negro, together with twelve major businesses in the Fray Bentos area (including ENCE and Botnia) has already formed a development agency with the

objective of creating strategic projects to address the regional development implications of the projects on the surrounding area. Partnerships have already formed with education facilities and new programs are in place to assist with the education and training of local and regional residents so that they may benefit from the opportunities created by the mill development. Welding programs have been set up at local high schools, traffic safety programs, computer education programs, and business skills are a few of the programs already implemented.

Providing additional opportunities for employment will encourage youth to remain in their community rather than to migrate to Montevideo or other large urban area in search for employment.

Community services and infrastructure will also be improved and expanded such as health care facilities, recreation facilities (e.g., golf course), municipal sewage treatment and housing.

4.12.2 Quality of Life

There will be changes in the quality of life for the population in the area of influence, most notably in Fray Bentos and in the surrounding area. The pace of life will increase with the influx of outsiders into the area, there will be an increase in traffic, noise, tourism and commercial activities. As Fray Bentos continues to develop, new opportunities will be created, making the city more attractive to youth and young adults. The out-migration of youth should decrease as these new opportunities develop.

Perhaps most noticeably will be the increased overall affluence experienced by many in Fray Bentos and the region. Increased affluence creates new choices related to improved living conditions, purchasing power, education and health care.

There will be a greater demand for, and supply of, cultural and recreational events and activities. These activities will be induced by market forces and regulated by the local institutions. For example, the increase in accommodation rentals will potentially lead to an overall increase in the cost of living in the city of Fray Bentos and in neighbouring localities.

There will be a tendency towards greater social stratification in the city of Fray Bentos with the influx of operational personnel for the mills and other related industries in the higher social and educational categories. The long-term presence of both mills will result in an overall more prosperous economy that attracts other forms of investment. The community will benefit from improved health care, education opportunities, and infrastructure. Investment in recreation and cultural activities will also be experienced during the operations phase, two indicators that contribute to an improved quality of life.

Actions planned or already implemented by ENCE and Botnia to deal with these quality of life issues include communicating with the public through:

- The use of a dedicated telephone number during construction for residents to use to ask questions, or express concerns;

- Botnia will publish a large circulation magazine in which it presents and analysis different topics related to its plants and activities in Uruguay and Finland, and has conducted a number of public forums to provide further information; and

- ENCE, jointly with the Faculty of Social Sciences of the University of the Republic, has conducted a number of public seminars with the members of the local civil society of Fray Bentos to explain the characteristics and implications of the construction works.

Negative impacts to the quality of life include an expectation of an increase in crime, sexually-transmitted diseases, and anti-social behaviour with an increasing population (Section 4.8).

4.13 Organizational Capacity

The success of social and environmental management activities depends critically on the capacity of the responsible organizations to implement their programs effectively. Sufficient human resources with the requisite skills to carry out their tasks are important elements for success. Ancillary and supporting resources are also required at appropriate levels and times for programs to be carried out effectively.

4.13.1 Corporate

The EIA documentation for the pulp mill projects outlines each project's commitments to social and environmental action plans to manage anticipated impacts from the projects. Overall, both companies have committed to programs that will pro-actively manage impacts within a social and environmental management system adequate to the task. These programs are described in Section 5.0 of this report.

4.13.2 Governmental

The issue of the Government of Uruguay's capacity to provide the in-country regulatory oversight of the pulp mill projects has been raised by some interested parties.

DINAMA is Uruguay's environmental authority. It is part of the Ministry of Housing, Territorial Arrangement and Environment (MVOTMA). DINAMA is responsible for formulating, executing, monitoring and evaluating the "National Plan of Environmental Protection". It is also responsible for proposing and implementing the National Policy of Environmental Protection, aiming towards sustainable development for the country.

MVOTMA also houses Comision Tecnica de Asesoramiento de Medio Ambiente (COTAMA). COTAMA is an inter-institutional and multi-sector entity that provides advisory

and coordination guidance on environmental issues. Its membership includes representatives from many ministries, government institutions, and NGOs. COTAMA was responsible for the formulation of the National Law of Environmental Protection.

DINAMA's responsibilities and duties include the following:

- Formulate, execute, supervise and evaluate plans to (i) to measure and evaluate the quality of environmental resources (water, air, etc), and (ii) prevent the negative environmental impact of human activities;
- Evaluate control plans of public and private entities that will impact on the quality of the environmental resources; and
- Formulate and coordinate actions with public and departmental entities for the protection of the environment.

DINAMA's licensing process and requirements are summarized in Section 1.4 of this report. DINAMA's organizational structure includes five departments: (i) Assessment of Environmental Quality, (ii) Assessment of Environmental Impact, (iii) Environmental Control, (iv) Protected Natural Areas, and (v) Administrative.

DINAMA has taken significant measures to prepare its staff for the tasks associated with regulating the two pulp mills. Staff members of DINAMA who the CIS team met with demonstrated a strong understanding of the issues associated with the regulation of these mills. In-house staff expertise appropriate for regulating such facilities includes process engineering, chemical engineering, aquatic ecology, fisheries biology, and environmental law. Several staff traveled to Europe to meet with the design engineers for Botnia and ENCE and to visit existing pulp mills operated by the proponents to strengthen their understanding of the process technologies and control measures for the proposed mills. They also met with local regulators within the respective jurisdictions to gain insight into the potential environmental and regulatory issues. DINAMA has developed a methodical and comprehensive permitting process that sequentially works through the various stages of project development and authorizations, yet have remained adaptive to new ideas to better address the management of these facilities.

4.13.3 International

Comisión Administradora del Rio Uruguay (CARU)

CARU was commissioned under the Rio Uruguay Statute that was endorsed by Argentina and Uruguay on February 26, 1975. It is a bi-national commission responsible to administrate affairs pertaining to the Rio Uruguay including those dealing with water uses and water quality. One of the most important responsibilities of CARU has been the

adoption of water quality standards[19] that both governments are committed to regulate. Requirements related to environmental monitoring have also been prepared and CARU has responsibilities to undertake joint monitoring.

Although CARU has been active in the administration of these responsibilities, the recent animosity between the two countries pertaining to the proposed pulp mills in Fray Bentos has undermined the ability of the commission to fulfill its mandate. In the meantime, the Government of Uruguay has decided to proceed unilaterally with regard to regulation and monitoring in connection with the Botnia and ENCE applications. CARU's function in monitoring water quality is a critical function and should be restored as soon as possible to help protect the overall quality of the river.

United Nations Environment Program (UNEP)

UNEP is not formally involved in the environmental regulation or monitoring of effects pertaining to the pulp mills, however, it was previously invited to contribute to monitoring activities by the Ministers of Environment of Uruguay and Argentina. To date, there are no planned or committed activities on behalf of UNEP in this matter.

4.13.4 Other Interested Parties

A number of other organizations and groups, including NGOs and other civil society representatives, have expressed interest in these projects in various ways. Overall, many parties are expected to have a role in developing the plans for the management and monitoring of the projects' effects. Such capacity is expected to benefit the local and regional social and biophysical environs and to assist in optimizing the projects' effects, including their cumulative impacts.

[19] CARA. Digest on the Uses of the Uruguay River. Administrative Commission of the Uruguay River, Paysandú, 1984.

5.0 CUMULATIVE IMPACT MANAGEMENT

The assessment of environmental impacts involves the determination of the type, magnitude, and duration of potential effects on the social and ecological environments in areas affected by the developments. Once these effects are elaborated, it is necessary to determine what actions should be undertaken to mitigate their impact, if necessary, and how the success of the mitigation actions will be measured. Monitoring programs are designed as part of the assessment process in order to implement the requirements of regulatory authorities as well as to measure predicted impacts and provide sufficient information to manage or further mitigate the impacts.

Once the specific activities associated with the development are elaborated, potential impacts identified and monitoring programs designed, the proponents must pull together the relevant information into comprehensive and action-oriented environmental and social management plans. These plans should cover all activities pertaining to all phases and operations of the development. Where the development has important consequences on the surrounding communities, these plans should also be integrated with well constructed and complete public communication and consultation procedures and programs.

The results of environmental and social monitoring studies and the implementation of emergency response measures potentially affecting the public must be communicated to the public in a clear and responsible manner. Public disclosure by all actors pertaining to the construction and operation of the mills must be transparent, rapid, inclusive, responsive, and, above all, unambiguous.

This chapter of the CIS addresses the key components and processes required for the development of environmental and social management planning, as required by DINAMA as part of the licensing process for the two proposed mills.

5.1 Environmental and Social Monitoring

Monitoring programs are an essential component of EIA and generally respond to two requirements. The first requirement is to monitor parameters such as those related to air and water emissions that are required by regulatory authorities (in this case DINAMA) to ensure that plant processes meet their design specifications with regard to applicable standards and guidelines. The second monitoring requirement responds specifically to potential impacts and is designed to define the magnitude or nature of any problem as well as provide input for additional mitigation, if needed.

Section 4.0 of this CIS document reviewed and summarized potential cumulative effects associated with the construction and operation of the Botnia and ENCE pulp mills. The two companies had previously undertaken an evaluation of specific impacts of their facilities and operations for which they developed mitigation strategies and specific monitoring programs. These programs are elaborated in their respective EIA documents and are

briefly summarized here. The CIS evaluation presented in this document also identified a number of additional monitoring activities designed to address specific cumulative impacts defined in this CIS.

5.1.1 Plantations

In general, most of the impacts resulting from the operation of existing plantations and the development of any new plantations were considered manageable. All of the company-owned plantations and most of those owned by third party contractors are certified under the Forest Stewardship Council sustainable forest management program which requires measurements and audits of social and environmental components. However, individual and cumulative impacts of potential significance relate to water management issues – both surface water and groundwater.

The CIS document (Annex B, Subsections 4.2 and 4.3) has recommended that the forestry companies supplying the two mills continue their participation in on-going Uruguayan State University studies pertaining to impacts on soils, surface water, and groundwater. In addition, both EUFORES and FOSA should ensure surface and groundwater monitoring is established at all of their large-scale plantations. Owners of any plantations located within the recharge area of the Guarani Aquifer should also assess and monitor groundwater quality (e.g., for traces of pesticides, herbicides, and nutrients) of their plantation lands.

5.1.2 Noise

The data provided by Botnia and ENCE indicate that there may be exceedences of the IFC standards for noise impacts at least during the construction phase (Subsection 4.5). Some exceedences may also occur in areas adjacent to plantations. The construction phase impact will be short- to medium-term and reversible. The plantation impact will be long-term but intermittent. The exact extent of the impacts has not been fully addressed in the EIAs and each company should undertake detailed monitoring of noise levels adjacent to plantations and the mills. In addition, they should prepare contingency plans to protect particularly sensitive receptors, such as recreational and residential areas, in the event of regular exceedences of IFC guidelines. These contingencies could include sound proofing and deflecting devices including vegetation planting and the construction of noise walls.

5.1.3 Air Quality

The maximum concentration of all air quality parameters occurs within the areas immediately adjacent to the mill properties. The CIS assessment (Subsection 4.4) indicated that air quality in these areas will remain in compliance with all respective air quality criteria under all operating conditions. The concentrations of substances in the atmosphere will increase slightly, but concentrations will remain less than 6% of the air quality criteria for all parameters with the exception of NO_2 (which is predicted to be 32% of the 1-hour standard) under normal operating conditions. Beyond this limited area and at the neighboring communities in Uruguay and Argentina, the potential change in air quality

for virtually all substances will be immeasurable. The only exception to this is the potential for infrequent occurrences (4 to 10 times per year) of detectable odour in the city of Fray Bentos and at the international bridge.

Both companies proposed to undertake monitoring of reduced sulphur compounds (TRS), but they did not specify pertinent receptors. It is thus recommended that monitoring of TRS be undertaken in Fray Bentos and at the international bridge.

5.1.4 Water Quality

The cumulative assessment of water quality in the Río Uruguay indicates that no water quality standards or guidelines will be exceeded as a result of the discharge of effluents from the two mills. However, chemical and biological monitoring in the river, in conjunction with mill effluent monitoring, is recommended to demonstrate the lack of adverse impact.

Recommendations for chemical monitoring of mill effluent are detailed in Annex A. In addition, toxicity testing of effluent is recommended, including both acute and chronic testing (Annex D, Section D7.1). If non-toxic results are consistently obtained, the need for such testing should be reviewed.

A plume delineation study is recommended, to be completed when the mills are operating normally (Annex D, Section D7.2). This will confirm the complete simulations of plume dispersion in the Río Uruguay.

Water and sediment quality monitoring programs are recommended, including upstream reference and downstream plume exposure locations (Annex D, Section D7.3). Water quality would be monitored bimonthly, for a comprehensive suite of chemical parameters. Sediment quality would be monitored every two to three years, for total organic carbon (TOC), grain size, pH, nitrogen, phosphorus, adsorbable organic halides (AOX), extractable organic halides (EOX), total phenolics, chlorophenolics, and dioxins and furans. This program will track any sediment nutrification effects, as well as any accumulation of toxic contaminants of concern.

Monitoring of benthic invertebrate community composition is recommended, concurrent with the sediment quality monitoring program. In addition, a selected benthic invertebrate (clam or mussel) would be collected for analysis of tissues for bioaccumulative substances, including chlorophenols, resin and fatty acids, phytosterols, and dioxins and furans.

A fish health survey similar to that conducted at many Canadian mills was deemed not to be a useful monitoring tool in this instance, because of the small size of the predicted effluent plume, consistent with Canadian regulations. Similarly, chemical monitoring of fish tissues was considered not to be needed. However, a conceptual fish monitoring program was developed (Annex D, Section D7.3), as a contingency measure, should a program be required in the future.

5.1.5 Compliance Monitoring Requirements

A monitoring and recording system is an essential element of BAT. In August 2006, DINAMA issued a preliminary compliance monitoring plan for the pulp mills in Fray Bentos requiring three levels of monitoring:

1. monitoring to be undertaken by the pulp mills for process control and environmental performance purposes, and which agrees with the Monitoring and Follow-up Plan to be presented to and approved by DINAMA;

2. monitoring that can be undertaken by the follow-up commissions established in the respective Initial Environmental Authorizations (AAP); and

3. monitoring to be undertaken through DINAMA with the objectives of industrial control and evaluation of the environmental quality. It is at this level that DINAMA defines the parameters to be monitored, location of sampling stations, frequency of sampling, responsible operators, and the analytic techniques and procedures.

Follow-up activities, as overseen by DINAMA, comprise two elements: the quantification of the parameters that characterize industrial emissions and environmental and ecosystemic quality (monitoring); and the audit of Management Plan implementation.

The Environmental Impact Assessments (EIA) submitted with the AAPs by each pulp mill contain a monitoring plan for environmental media in the impacted area. Additional monitoring requirements will be included in specific authorizations issued by the Ministry of Housing, Land Use Planning, and Environment (MVOTMA). A central part of the approval for both the AAPs and the Environmental Management Plan (PGA) for the Botnia and ENCE plants is the requirement of comprehensive monitoring of environmental impacts in different environmental media, including in the Río Uruguay. Both companies are required to engage in extensive monitoring prior to operations of the plants to establish a baseline condition of the Río Uruguay. Monitoring should include superficial water (including sediments, fish and benthic fauna), air, soil and groundwater, terrestrial biota, noise and social aspects.

The AAPs of both Botnia and ENCE set forth parameters with which their monitoring plans must comply and DINAMA has indicated that the monitoring requirements may be modified. Indeed, pursuant to the AAO procedure, DINAMA will review each plant's monitoring plans every three years and if necessary, will require additional monitoring to ensure the avoidance of negative environmental impacts. The monitoring data collected for the construction and operation PGAs will be submitted to and evaluated by DINAMA. If unacceptable impacts are observed, DINAMA is to take appropriate action.

Each of the two mill proponents must submit their compliance monitoring program to DINAMA for approval before being awarded the remaining PGAs and AAOs. Both mill

proponents have produced preliminary versions of these plans and discussed them with DINAMA. These preliminary plans indicate end-of-pipe and end-of-stack parameters to be monitored, the frequency of monitoring, points of measurement, and primary responsibilities for monitoring.

The requirements for compliance monitoring are critical to ensure that the mills are well operated at all times. Establishing the compliance monitoring requirements is a task that DINAMA and the two proposed mills are addressing incrementally and carefully. The permit requirements have not been established at the time of this CIS writing and thus the compliance monitoring requirements cannot be explicitly stated. However, there are certain important principles that should be considered in establishing these compliance monitoring requirements:

1. DINAMA has indicated that they will establish loading-based requirements in addition to concentration-based requirements. Concentration-based requirements, while required by Decree 253/79, restrict the mills' ability to decrease flow and achieve energy efficiency, especially with regards to effluent contaminants such as metals. The loading-based requirements should be considered the most pertinent and should include a more conventional time-averaging requirement, e.g. 24 hours.

2. Because DINAMA is responsible for requiring 4-hour maximum concentration values, continuous monitoring techniques should be used if and where possible for the effluent, including inferential techniques.

3. The variability in mill effluent discharge that needs to be accounted for between long term average discharge and various time maxima, e.g. 4-hours, daily or monthly maxima, is unique to each mill and depends on a number of complex factors. The variability that is considered in setting the loading-based permit requirements should be evaluated based on actual effluent data once production has stabilized.

4. Effluent flow limits should not be specified in permits since, as per point 1 above, load-based requirements are recommended. A flow-based requirement will not enhance environmental performance although it may have possible production and environmental consequences.

5. Air monitoring requirements should be specified on a source basis and not on a stack basis, e.g. for the recovery boiler, lime kiln, etc. in order that the data can be used to verify BAT.

6. DINAMA should establish effluent and emission limits rather than specifying in-process requirements as this may have possible consequences within the mill process.

7. An allowance should be attributed in the permits during start-up and shutdown of certain major equipment items, e.g. boilers, and during an initial operating period for the mills.

8. DINAMA will include a requirement for AAO renewal every three years. It is recommended that in addition to this a re-permitting exercise be required should a production increase threshold be surpassed.

5.1.6 Solid Waste

The solid waste assessment (Subsection 4.7) indicated that groundwater monitoring will take place in association with their proposed solid waste landfills along with the monitoring of waste type and amount going into the landfills. The companies will not generate significant amounts of hazardous waste but the quantities generated will be disposed of in an appropriate fashion that meets international standards (see Subsection 4.7.3). It is recommended here that the companies should also monitor the type and amount of such waste generated as well as ensure that an appropriate waste transportation tracking procedure is implemented.

5.1.7 Social and Economic

Economic and employment impacts (Annex E, Subsections 4.8 and 4.9) associated with the construction and operation of the two mills are considered to be significant and positive to the economy, particularly in Fray Bentos and the Department of Río Negro. However, the increase in demand for local services and changes in quality of life in these areas may have a negative impact. Tourism activities may be affected due to visual changes and the perception that there may be an increase in pollution associated with the operation of the mills.

Monitoring programs for air quality and water quality already planned by the companies will assist in future assessments of social impact mitigation. In addition, Botnia has commenced a detailed social monitoring program based on a number of indicators. The social and economic CIS assessment recommends that both companies co-operate in undertaking their monitoring programs. The CIS document (Annex E) provides specific monitoring program recommendations pertaining to indicators, sub-indicators, locations, and frequency. The indicators include housing, policing, health care, education, employment, tourism, fishery resources, farm resources, and beekeeping. Generally, most of the monitoring is recommended for Fray Bentos, Río Negro and Paysandú on a quarterly, semi-annual, or annual basis.

5.1.8 Transportation

Transportation impacts (Annex F, Subsection 4.10) resulting from the construction and operation of the mills as well as from the shipment of logs from plantations to the mills are considered negative due to increased traffic and congestion. Increased river traffic to

export the pulp will be more or less offset by the decreased river traffic due to elimination of former pulp log and woodchip exports. It is recommended that the Uruguayan Government periodically monitor the impact of truck traffic along the primary routes between the mills and the plantations.

5.1.9 Energy

The cumulative impacts pertaining to the energy requirements of the mills are considered overall to be positive. This conclusion is based on the fact that fuel oil will be substituted with biomass to fire the boilers of both mills and electricity will be provided to the national grid. Also, the use of wood waste for energy generation may reduce negative impacts related to the disposal of these materials. No monitoring programs are recommended for this sector.

5.1.10 Regional Development

The companies and local government officials and civil organizations are working together to develop social and environmental action plans that will increase local and regional development opportunities as well as community programs and activities. These should result in net benefits related to education, training, employment opportunities, and improvements to community infrastructures relating to health care, recreation, and utilities. Alternatively, quality of life will be impacted both positively (increased wealth and services) and negatively (increased population, congestion, and demand for services). The companies are planning to institute a number of community communication actions to respond to problems as they may arise. No specific monitoring programs are proposed for this sector although the program recommended for social and economic impacts will respond to negative impacts pertaining to community services.

5.2 Environmental, Social and Corporate Management Planning

Detailed environmental management plans are designed to cover all phases and activities of the development. These plans are critical to ensuring that the results of the initial impact assessments are properly implemented and followed through with. They include specific actions to be taken with regard to on-going monitoring and responses to unplanned but predictable events; responsibilities and chain-of-command within the company; contact procedures (both in-plant and community, as required); staff actions to be taken (including both technical response and health and safety measures); reporting requirements; and follow-up. It is essential that such plans be kept up-to-date as procedures, staff, and contact numbers change. Further, they must be implemented via company policies which include staff orientation, education, and training (including simulations of events).

Botnia and ENCE have prepared a wide range of documentation pertaining to their internal management processes. These include corporate social and environmental policies,

organizational structures and responsibilities, environmental control procedures, the management of risks, emergency and contingency plans, staff training requirements, operational auditing, and public communications and consultation. Botnia has provided their corporate environmental policies along with relevant project specific information within their EIA Summary Document (Chapters 4 and 5) and in Section 8 of the main EIA. ENCE has prepared a separate document referred to as an environmental and social action plan (Plan de Acción Ambiental y Social, ESAP) which includes a summary of corporate environmental policies and specific project management plans for a variety of activities.

Botnia's EIA documentation focuses on their proposed mitigation and monitoring programs but also identifies potential risks related to plant process equipment and spills. The documentation includes specific actions and design measures intended to reduce or eliminate such risks as well as the need to develop specific operational emergency plans for each mill process. In February 2006, Botnia provided a schedule for the completion of their ESAP. Most elements will be completed by the time the mill commences operations. Table 5.2-1 shows the tasks associated with this plan, the task deadline, and the status as of February 2006.

A social and environmental action plan was prepared by ENCE in 2006 (August 2). This document provides a summary of corporate management policies pertaining to environmental and social responsibilities and to health and safety. Specific plans and their basic content are outlined in Table 5.2-2.

Table 5.2-1: Schedule and Status of Botnia's Environmental and Social Action Plan

Task	Deadline	Status
1. Develop & Implement an Integrated Management System for Environmental + Occupational Health & Safety issues and achieve certification to ISO 14001 + OHSAS 18001	1 year post start up	Not yet started. Will include: • Quality Management System ISO 9001:2000 • Environmental Management System ISO 14001:1996 • Occupational Health and Safety Management System OHSAS 19001 • Chain of Custody of Wood SMS 1003 • HACCP System DS 3027:2002 • Inspection of Renewable Energy Production (RECS)
2. Develop & Implement a Hazardous Material Management Plan as specified in IFC guidelines	Prior to start up	Preliminary plan prepared.
3. Develop and Implement an Emergency Response Plan to cover expected emergency events and impacts on plant and on the surrounding communities	Prior to start up	Preliminary plan presented to IFC.
4. Develop and Implement a transportation plan including road and river transport of wood and pulp all the way to the export terminal	Prior to disbursement	Preliminary plan prepared.
5. Develop a community development plan to guide future community based actions	Prior to commitment	Preliminary plan presented to IFC. Recently revised.
6. Develop a strategy and detailed plan for conservation set aside as per the permit	Prior to disbursement	FOSA has presented Mafalda area to DINAMA (Botnia will file in DINAMA). Plan also presented to IFC.
7. Develop detailed design and operational procedures for landfill and for the hazardous waste storage cell and submit to IFC for prior approval	Prior to construction of the landfill	Landfill design ongoing.
8. Implement groundwater monitoring program in FOSA owned plantation holdings	Prior to disbursement	Planned monitoring presented to IFC.
9. Demonstrate that IFC's standards on environmental and social impact assessment, as well as on issues of occupational health and safety are fully met at the site to be used primarily for the export of the pulp	Prior to disbursement	Audit planned in February 2006

Table 5.2-2: Contents of ENCE's Environmental and Social Action Plan

Plan Title	Description
1. Pollution Abatement and Prevention	Technological investments adopted to mitigate the environmental impacts during the operation of the mill.
2. Construction Management	Construction phase mitigation actions.
3. Hazardous Materials Handling.	Hazardous materials management guidelines.
4. Emergencies	Emergency prevention and response.
5.Transportation	Management of impacts associated with water and road transportation.
6. Community Plan Development	Community action planning for social activities and programs.
7. Natural Resource Conservation	Environmental conservation and protection actions.
8. Solid Waste Management	Procedures for the collection and disposal of solid wastes from industrial operations.
9. Hydrological Resources	Design of studies pertaining to the effect of plantations on the hydrological cycle.
10. Environmental Monitoring	Monitoring and follow-up of air emissions, liquid effluent, solid waste and other environmental elements.
11. Public Communication and Consultation	Procedures for communicating environmental and social monitoring/study results. Communication channels and opening with the community on the environmental and social performance.

5.3 Public Disclosure

The International Finance Corporation contracted a study of stakeholder concerns and interests pertaining to the proposed development of the two mills (Annex G). This study involved direct interviews of a wide range of interested stakeholders in person and over the phone. One of the key products of this study was the elaboration of a set of principles which should be incorporated into meaningful public engagement and dialogue. These principles are extremely relevant and should form the basis of continued interactions among the stakeholders, industry, government, and civil society. They are as follows:

- be meaningful and transparent;
- include broad stakeholder representation;
- provide opportunity for review of credible information;
- respect sovereignty; and
- ensure a safe space for civil discussion.

In this regard, both ENCE and Botnia are committed to ensuring that data pertaining to the operation and potential influence of the mills is readily available for public dissemination and is in a form that the lay public can understand. As required, all routine monitoring program data will be provided to DINAMA as scheduled in the mills' individual operations permits. As such, once in DINAMA's hands, the information will be in the public domain and should be made widely available. In practice, however, it is suggested that the mills should also disseminate key performance data in a proactive manner. It should be noted that DINAMA has required that each mill proponent participate in a "Follow-Up Committee" once operations have commenced. These committees will be presided over by the Ministry of Housing, Territorial Planning, and Environment (MVOTMA), and will be made up of various governmental entities and representatives of the local communities. These committees will allow both the government and the local community to access information about the environmental impacts of the mills. In addition to the committees, the mills should use a public information/community development centre in Fray Bentos, or similar mechanism, as a means to distribute information. The centre should have an area dedicated to the measurement of environmental performance and should include, among other things, data relevant to effluent and receiving environment quality.

Effluent and air quality data will be represented by several key measures that are indicative of the performance of the effluent treatment plants and the overall quality of the effluents. It is proposed that effluent flow, COD, conductivity, and TRS data will be reported to the public to reflect daily operating performance. It is also proposed that acute toxicity data be reported to demonstrate the continued non-toxicity of the effluent. Along with the data itself, regulatory criteria (if applicable) and measures of "typical" mill performance will also be shown for comparative purposes. "Typical" mill performance is to be expressed as the long-term monthly average value (i.e., the average of monthly averages for all available data) and the maximum monthly average (i.e., maximum monthly average for all data available). As indicated, these data will be in a format readily understood by the lay public (pictorial where possible) with full and clear explanation of the information provided where appropriate and/or necessary.

Receiving environment quality data generated by the proposed routine monitoring will also be reported to the public in a timely manner. It is suggested that data for a few key water quality parameters (e.g., conductivity, dissolved oxygen, nutrients) be tracked and shown graphically as data permit for a subset of the proposed sampling stations. Data for the stations upstream and downstream of the mill discharges, as well as at Yaguareté Bay and the water intake for the City of Fray Bentos, would serve for these purposes, providing the public a broad spatial understanding of water quality conditions in the area. Other routine monitoring data (fish, benthos) would be available on a regular but less frequent basis (as defined by the proposed schedule for each), and would be brought forward when available.

It is suggested that a quarterly information circular might be the best vehicle to communicate this information. This quarterly publication would track the environmental performance at the mill, summarize the real time data that are also provided as stand-alone

performance indicators, and describe major mill events that may have occurred. The mills should also use the Internet to distribute this information to help broaden public/stakeholder access. Although common, Internet access is by no means universal in the greater Fray Bentos area. Nevertheless, it would seem reasonable to expect that local Internet use will increase in the future, and that at some point this medium will become a much more significant component of the overall communications plan of each mill. The Internet can also enable more frequent reporting of some of the key environmental quality monitoring results indicated above.

Finally, although the audience might be somewhat limited for the detailed scientific reports that will be generated through routine environmental monitoring, hardcopies (paper) and electronic copies (PDF) of all receiving environment and effluent-related studies will be maintained in a catalogued library at the proposed public information centre in Fray Bentos.

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