

LATIN AMERICA

Project for the Environmental Protection and Sustainable Development
of the Guarani Aquifer System

GEF PROJECT BRIEF

Latin America and the Caribbean
LCSES

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Project ID: P068121	Sector(s): VM – Management of Natural Resources
	Theme(s): Environment, Water
Focal Area: I – International Waters	Poverty Targeted Intervention: N

Project Financing Information	
<input type="checkbox"/> Loan	<input type="checkbox"/> Credit
<input checked="" type="checkbox"/> Grant	<input type="checkbox"/> Guarantee <input type="checkbox"/> Other:
For Loans/Credits/Other:	
Total Project Cost (US\$m):	Cofinancing: Yes
Total Financing by the IBRD (US\$M): 0	
Has there been a discussion of the IBRD financial product menu with the borrower? _ Yes <u>x</u> No	

Financing Plan: Sources		Total US\$ Million
Recipients		12.10
Global Environment Fund		13.40
Co-Financing: IAEA, BGR, Bank-Netherlands Water Partnership Program (BNWPP), Beneficiaries		1.26
TOTAL IMPLEMENTATION:		26.76
Preparation:	GEF/Block B	0.54
	Recipients	1.03
	OAS	0.08
	BNWPP	0.25

Estimated Disbursements (Bank FY/US\$M):

FY	02/03	03/04	04/05	05/06				
Annual		7835.9	8680.5	6427.9				
Cumulative	3812.3	11648.2	20328.7	26756.6				
Project Implementation Period: 4 years								

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LIST OF ACRONYMS

ABAS	Brazilian Groundwater Association
ABRH	Brazilian Water Resources Association
BNWPP	Bank Netherlands Water Partnership Program
BGR	Bundesanstalt fuer Geowissenschaften und Rohstoffe – German Federal Institute for Geosciences and Natural Resources
CC	Coordination Group – Coordinación Colegiada
CAS	Country Assistance Strategy (World Bank)
CORPOSANA	National Corporation for Water Supply and Sanitation (Paraguay)
CSDP	Guarani Project Steering Committee
CSO	Civil Society Organizations
DINAMIGE	National Directorate for Mining and Geology (Uruguay)
DNH	National Hydrographical Directorate (Uruguay)
EMBRAPA	Brazilian Corporation for Agro-Pastoral Research (Brazil)
IA	GEF Implementing Agency
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development/ The World Bank
INA	National Institute for Water (Argentina)
IW	GEF International Waters Program
GEF	Global Environment Facility
GIS	Geographic Information System
IAEA	International Atomic Energy Agency
IWRN	Inter-American Water Resources Network

MERCOSUR	Southern Common Market [Argentina, Brazil, Paraguay, and Uruguay]
MMA	Ministry of Environment (Brazil)
NGO	Nongovernmental organization
OAS	General Secretariat of the Organization of American States
OP	Operational Program
OSE	National Sanitation Service (Uruguay)
PDF/B	Project Development Facility, Block B
REA	Regional Environmental Assessment
SAP	Strategic Action Program
SG	Secretariat for the Guaraní Project
SEAIN	Secretariat for International Affairs (Brazil)
SENASA	National Sanitation Service (Paraguay)
SRH	Secretariat for Water Resources (Brazil)
TDA	Transboundary Diagnostic Analysis
UNEP	National Coordinating Unit for Project Execution
WB	World Bank

A. Project Development Objective

1. Project Development Objective: (see Annex 1)

The long-term objective is the sustainable, integrated management and use of the Guarani Aquifer System. The Guarani Aquifer System is situated in the eastern and south central portions of South America, and underlies parts of Argentina, Brazil, Paraguay, and Uruguay. This project is a first step toward achieving the long-term objective. It is to support the four countries in jointly elaborating and implementing a common institutional and technical framework for managing and preserving the Guarani Aquifer System for current and future generations. To provide such support, seven project components are envisaged: (i) expansion and consolidation of the current scientific knowledge base regarding the Guarani Aquifer System; (ii) joint development and implementation of a Guarani Aquifer System Management Framework, based upon an agreed Strategic Program of Action; (iii) enhancement of public and stakeholder participation, social communication and environmental education; (iv) evaluation and monitoring of the project and dissemination of project results; (v) development of regionally-appropriate groundwater management and mitigation measures in identified “Hot Spots”; (vi) consideration of the potential to utilize the Guarani Aquifer System’s “clean” geothermal energy; and, (vii) project coordination and management. These are elaborated in Annex 2.

2. Key performance indicators: (see Annex 1)

The principal performance indicator against which the Project will be measured is the existence of an overall Guarani Aquifer System Management Framework (Strategic Action Program), including technical, scientific, institutional, financial, and legal aspects, for the sustainable management and protection of the Guarani Aquifer System in the four countries. Key performance indicators with regard to this overall framework will include process indicators, stress reduction indicators, and environmental status indicators:

Process Indicators

- the existence of a multi-country agreement on the institutional and technical framework for the management of the Guarani Aquifer System;
- the existence of a Transboundary Diagnostic Analysis, identifying the primary threats to the structure, function, and sustainable use of the Guarani Aquifer System, including the location of areas under current threat and in need of immediate attention (i.e., “hot spots”);
- the existence of a Strategic Action Program for the sustainable management of the aquifer, including programs for:
 - the operation and maintenance of the data acquisition and monitoring system
 - the implementation and sustainable operation of the legal-institutional framework once such a framework is approved and adopted by the countries
 - investments in pollution prevention and mitigation measures
 - investments in geothermal energy use
 - the resolution or mitigation of existing and potential conflicts;

- the existence of a consensus proposal for a joint legal framework for the management of the Guarani Aquifer System;
- the existence of a functioning monitoring network.

Stress Reduction Indicators

- an operational communications campaign, with a defined percentage of the target population reached;
- identified and quantified water quality threats and their evolution;
- existence of norms for well design, construction and maintenance at a regional scale, taking into account sub-regional variations;
- identified and documented pollution mitigation and groundwater depletion together with management measures implemented and monitored in specific “hot spots”.

Environmental Status Indicators

- agreed goals, criteria and standards for the transboundary diagnostic analysis and sustainable management of the Guarani Aquifer System, including quantitative and qualitative indicators upon which priority actions can be identified and implemented;
- defined western and southern boundaries of the aquifer system, as well as defined recharge and discharge areas, surge zones as well as vulnerable areas, including those with higher degrees of environmental risk;
- completed conceptual and mathematical models of the aquifer system, including elements its water quality, quantity, and hydrodynamic behavior;
- implementation of an up-to-date, functioning Information System, shared among the four countries, as a mechanism for transboundary information-dissemination, decision-making support, and management of the Guarani Aquifer System.

B. Strategic Context

1. Sector-related Country Assistance Strategy (CAS) goal supported by the project: (see Annex 1)

	Document number:	Date of latest CAS discussion:
Argentina	CAS 20354-AR	09/08/00
Brazil	CAS 20160-BR	03/06/00
Paraguay	CAS 16346-PA	03/06/97
Uruguay	CAS 20355-UR	05/05/00

Water resources management issues are prominent in the four Country Assistance Strategies (CASs). For each country, the water sub-sectors (water supply and sanitation, irrigation, etc.) are recognized as being sustainable in the long run only if the resource base itself is managed sustainably. The World Bank and respective governments recognize this, within an appropriate context for each country, through the respective CASs. This project, through its catalytic effect, will incorporate groundwater issues into the water resources management agendas of the four countries, including specific steps with regards to the Guarani Aquifer System. The integration of the proposed project into the CAS objectives for each country is highlighted below.

Argentina CAS: One of the main development challenges within Argentina is water resources management. Serious water quality problems are emerging due to aquifer “mining” and vertical contamination of water tables that could have economic consequences within the next 15 to 25 years. The World Bank CAS gives special attention to water resources management and envisages future support that will focus initially on institutional capacity building, including development of tradable water rights with incentives for efficient and sustainable water use, and a watershed approach to the integrated management of water, soils, and cultivation. The CAS also specifically states that the World Bank will continue to seek opportunities to expand the use of GEF grants as a complement to national programs and stimulate innovation with respect to global water resources issues. In a recent Water Resources Sector Study, groundwater was identified as one of the critical water resource issues in Argentina. The Guarani Project would contribute to capacity building in the fields of both groundwater management and sustainable management of water resources in the country, as envisaged in the CAS.

Brazil CAS: The World Bank would continue its strong involvement in water resources management. This involvement aims to support ongoing development of the legal and institutional framework for efficient, integrated, and decentralized water resources management in Brazil. In this context, however, groundwater has been largely neglected. The proposed project, in addition to addressing an important aquifer system (providing water for domestic and industrial purposes to more than 500 municipalities in eight states), is expected to contribute to the integration of groundwater management issues into Brazil’s overall water resources agenda of Brazil and to foster an integrated water resources management and protection vision.

Paraguay CAS: The World Bank has agreed to prepare a Natural Resources and Environmental Management Strategy for Paraguay in order to increase the likelihood of sustainable economic growth. This Strategy will assist in defining priority environmental pollution problems, and suggest possible policies for reducing pollution from the industrial, transportation, and water and sanitation sectors. It also will reassess priorities for natural resources management and prioritize future assistance for environmental management. Such actions will definitely strengthen the rather weak water management scenario that prevails, where groundwater plays a low-key role. In addition, the Government has expressed an interest in preparing a GEF country program to enhance capacity building within the water resources sector, with an emphasis on groundwater and natural resources management.

Uruguay CAS: The CAS identifies a number of local and global environmental issues on the policy agenda. Inadequate natural resource management could jeopardize the otherwise promising performance within the livestock and agricultural sectors. Poor water resource management is widespread, leading to inefficient water use and increased pressure on water resources. There are water quality problems in some sub-sectors. For these reasons, water resources management is a priority of the Government. The World Bank CAS identifies water resources management as a cross-cutting theme, extending across the agricultural and livestock sectors, the marine fisheries sector, and the tourism sector, particularly in the coastal zone. The Guarani Aquifer System underlies about 25% of Uruguay and constitutes about 40% of the country's groundwater resources. It is of importance to the different

water-using sectors identified in the CAS. The on-going Uruguay water resources sector study complements the proposed project which would contribute to groundwater conservation in Uruguay.

1a. Global Operational Strategy/Program objective addressed by the project:

The Guarani Aquifer System is a strategic water resource within the MERCOSUR region (see Annex 6). It can be preserved if adequately protected and managed. The main threats to the resource stem from uncontrolled abstraction, and pollution in the extraction and recharge areas. Given that groundwater recharge is restricted, and that groundwater pollution is reversible only at very high cost, if at all, there is considerable merit in protecting the Guarani Aquifer System for current and future generations.

The Guarani Aquifer System is a clear example of an international (*transfronterizo*) waterbody threatened by environmental degradation through over use and pollution, as defined and included in the GEF Operational Program Number 8. In the absence of a strategic intervention, supported by the GEF, the likelihood of “business-as-usual” prevailing in the four countries is high. At the aquifer’s current rate of use, and considering the growing use of groundwater for human consumption, it is easy to foresee an increasing threat of pollution and depletion in the not too distant future. Uncontrolled use, without rules or regulation, can alter the status of the Guarani Aquifer System from that of a strategic reserve of drinking water to that of a degraded waterbody that is the source of conflict among the countries. If nothing is done, the future of the Guarani Aquifer System could be the same as that of other shallow aquifers that have tended to become both polluted and over-exploited, at least in certain areas.

The global benefit of the proposed project is in terms of the preservation of this transboundary resource for current and future generations. In the specific case of the Guarani Aquifer System, there is the opportunity to exploit the advantages of preventive activity. The project would ensure that, in the face of increasing scarcity and pollution of surface water sources in the beneficiary countries, this resource is managed today so as to be available as a strategic reserve when needed in the future. An important issue to be considered in this regard is the fact that an international legal framework for the management of transboundary groundwater resources currently does not exist. Annex 7 sets forth a consideration of the potential root causes of the issues facing the Guarani Aquifer System, based on information gathered during project formulation. This latter assessment will be refined through the development of a Transboundary Diagnostic Analysis under Component II of the proposed project (see Annex 8 for a description of the GEF process).

It should also be noted that the World Bank, for example, does not have a specific policy on groundwater resources. This issue is being addressed in the ongoing evaluation of the World Bank Water Resources Policy Paper of 1993. It is generally recognized that transboundary groundwater issues need to be addressed, as projects are often proposed and implemented in areas where a situation of scarcity and competition for groundwater resources already exists (e.g., in North Africa and the Middle East). In the case of the Guarani Aquifer System of South America, the World Bank, through the GEF, could make a significant contribution to shaping an institutional framework regarding transboundary

groundwaters that could serve as a replicable model in other countries and regions. In addition, the experience derived from this project would be expected to contribute to GEF and World Bank policy with regard to transboundary groundwater issues.

2. Main sector issues and Government strategy:

The importance of groundwater, especially of large, deep aquifers, stems mainly from the fact that these resources constitute a strategic reserve for water supply. Such groundwaters rarely need to be treated prior to consumption. Natural biogeochemical filtering processes within the aquifers generally achieve a quality far beyond that which could be obtained, in technical or economic terms, by the available water treatment methods applied to waters withdrawn from rivers, lakes, or impoundments. Groundwater is frequently the most viable water supply alternative, especially where surface waters are polluted by domestic and industrial effluents, solid wastes, or contaminated agricultural runoff. Consequently, sustainable use, development and recharge, and diligent conservation, consistent with the protection of the aquifers from pollution, should be important concerns. As a transboundary aquifer with thermal qualities, the Guarani Aquifer System touches upon three sectoral areas; namely, sustainable water management (of groundwater in particular), transboundary water management, and energy use. These areas are elaborated below.

Sustainable (Ground)water Management: In the four countries overlying the Guarani Aquifer System, water sector issues include: institutional arrangements for integrated water resources management, and investments in water infrastructure and sustainable management of that infrastructure. An important issue in all four countries is water pollution. With respect to groundwater, this issue translates into a package of topics related to: (i) the recognition of groundwater as a resource in need of far more attention than it has been given to date; (ii) integration of groundwater management concerns into overall water resources legislation (which tends to focus on surface water); (iii) assessment of groundwater availability (related to quantification and modeling of the resource, including availability and demand scenarios); and (iv) groundwater protection measures (zoning, water rights, and design, construction, extraction and pollution controls). Overall, these issues have not been adequately addressed in any of the countries, although the governments are now moving toward completing an assessment.

Transboundary Waters: The beneficiary countries have long-standing experience in collaborating on transboundary water issues, most notably with regard to the Plata River basin which has had a general treaty and an Intergovernmental Committee since the 1960s. In addition, bilateral projects and specific treaties exist with respect to other water systems, such as the Uruguay River (Uruguay and Argentina), and the Paraná River (Brazil and Paraguay). To date, the success of these agreements has been mixed, especially with respect to hydrological allocation and pollution control issues. The countries do recognize, however, the importance of cooperation in transboundary waters issues. The attempt to reach an agreement on groundwater is a historical first and will certainly enhance the dialogue on other waterbodies within the region and may contribute to improve water management at a transboundary level.

Energy Use: In the context of this project, aspects related to energy use are of relevance. First, the four countries use different types of resources to satisfy their energy needs, ranging from hydropower to petroleum and gas. With increasing economic growth in the Region, energy demands are rising, too, leading the countries – to varying degrees – to look for more efficiency in the use of their current sources and also for substitutes. This is especially the case for heavily hydropower-dependent Brazil, which is currently passing through an energy crisis due to drought and increased energy demands. Concurrently, all four countries are signatories of the Kyoto Protocol for Global Warming, and, as such, have made commitments to look for alternative, “clean” energy sources. In this context, a careful assessment of the potential for the use of the Guarani Aquifer System waters for low-enthalpy energy may provide alternatives to fossil-fuel based energy sources, and opportunities for local energy savings for industry, irrigation, and/or domestic hot water supply.

3. Sector issues to be addressed by the project and strategic choices: (see also Annex 7: Root Cause Annex)

The available reference documents, including those prepared during the project preparation phase and summarizing the available knowledge on the Guarani Aquifer System, are listed in Annex 9. The importance of, and current knowledge about, the Guarani Aquifer System in the four countries is summarized in Table 1. Table 1 shows that actions in one country may have effects in the other countries. For example, uncontrolled drilling and extraction in one country, combined with pollution, may affect not only that country but also its neighbors. Therefore each country needs to jointly participate in the sustainable management of the resource to preserve its own share for the future.

Table 1: Current Knowledge and Importance of the Guarani Aquifer System in Argentina, Brazil, Uruguay, and Paraguay

Characteristic	Argentina	Brazil	Paraguay	Uruguay
Approximate Extent of the Aquifer (km²)	225,500	839,800	71,700	45,000
Percent of Territory Occupied	6	10	18	25.3
Characteristics of the Aquifer	Supply source	Recharge and supply area	Recharge and supply area	Recharge and supply area
Extent of Exploitation	9 deep wells for thermal use	300 to 500 cities partially or entirely supplied by the Aquifer System (70% of use); industrial uses (25%), irrigation and recreational uses (5%)	About 200 wells, mainly for domestic water supply	135 wells for public water supply, 7 of which are for thermal use

Principal Environmental Issues	1. Potentially uncontrolled drilling and extraction 2. Subject to pollution from other countries	1. Point and nonpoint source pollution 2. Uncontrolled drilling and extraction	1. Point and nonpoint source pollution 2. Uncontrolled drilling and extraction 3. Subject to pollution from other countries	1. Point and nonpoint source pollution 2. Uncontrolled drilling and extraction 3. Subject to pollution from other countries
Level of Information	Limited information available, especially about the western extent of the Guarani Aquifer System	Considerable information available but dispersed in different states and institutions	Limited information available	Considerable information available

Sustainable (Ground)water Management: The general sector issue affecting all four countries is the current lack of a management and administrative mechanism governing groundwater in the region. Recommendations for controlling drilling, extraction, and pollution would be an outcome of this project. Sub-sectoral issues relate to water supply, industry, and tourism, as well as environmental management within recharge areas. To manage these issues, both over-utilization and pollution of groundwater will need to be addressed.

The extent of available technical information, legal instruments, and institutional planning is very uneven within the four countries. Brazil is the only country that has legislation relating to the sustainable use of water resources, including groundwater. However, the legal basis is still relatively fragile and needs to be further developed together with improving law enforcement. Uruguay is operating under its 1979 Water Code, which does not include an economic value for water. In Argentina, the federal Constitution explicitly reserves ownership of natural resources within their jurisdictions to the provinces. The Argentine institutional framework, therefore, distributes responsibilities and decision-making authorities at different levels, creating significant overlaps between provincial authorities. In Paraguay, the situation is similar, although some attempts are being made by the Ministry of Planning (STP) to improve the coordination and regulatory framework for water resources management generally. Thus, not only must the sectoral issues be addressed in terms of the lack of a transboundary framework for groundwater management, but also jurisdictional issues must be clarified with respect to transboundary groundwaters in Brazil and Argentina. In addition, groundwater management arrangements at the national and subnational level must be addressed.

This project is expected to contribute to better groundwater management by raising awareness regarding groundwater issues, building local capacity for groundwater management, and strengthening national legislation for groundwater management. In the case of Brazil, a specific outcome of the project preparation activities has been the creation,

during June 2000, of the Permanent Technical Committee for Groundwater (*Câmara Técnica Permanente de Águas Subterrâneas*) within the National Water Resources Council. Subsequently, the Council adopted a resolution establishing guidelines for the inclusion of groundwater within Brazil's Integrated Water Resources Management System. As a complement, the Brazilian Government launched a National Groundwater Program in early 2001. In Argentina, as a specific outcome of the project preparation, the National Government solemnly created the Interministerial Committee for Groundwaters, to help improve integrated water management. In the case of Uruguay, the Government issued a decree controlling the drilling of wells in the Guarani Aquifer System area, providing a basis for management activities once the proposed project is underway. These actions show both the commitments of the countries to integrate groundwater into their overall water resources legislation, and the impact that this high-profile project is having on an otherwise largely neglected resource.

Transboundary Waters: The proposed project should be viewed not only within the context of the previously mentioned agreements on surface water resources, but also with regard to their future. Early actions to address issues such as pollution, communications, conflict management, and water allocation, among others, are priorities in the context of the Guarani Aquifer System. These preventive actions will take advantage of the joint water resources agreements and treaties that currently exist, while adding the groundwater perspective. A consequent light but effective, joint management framework will provide a basis for transboundary collaboration between the countries concerned.

Energy: The project will consider the thermal characteristics of the waters of the Guarani Aquifer System. Based upon current information, the thermal waters are located within pockets in some localities. Current indications are that these thermal waters are unlikely to provide significant energy generating potential due to their relatively low temperature (less than 50°C). However, a variety of other uses may be possible, ranging from district heating and provision of warm tap water, to thermal tourism (already highly important in northwestern Uruguay), to industrial uses. The proposed project will review alternatives for the use of thermal waters as a “clean” energy source, and, depending on the outcome of these investigations, will identify opportunities to modify local energy use and policies so as to substitute for the use of fossil fuels.

C. Summary Description of the Project

1. Project Components (see Annex 2 for detailed descriptions and costs):

The project is comprised of six components, supported by an administrative component. GEF: US \$ 13.40 million; co-funding: US \$ 13.36 million; total: US \$ 26.76 million.

COMPONENT I: Expansion and Consolidation of the Current Scientific and Technical Knowledge Base on the Guarani Aquifer System

Component I develops a sound scientific and technical basis for the determination of the priority transboundary issues and associated strategic remedial actions for the protection of the Guarani Aquifer System. It is essential for the determination of an appropriate joint

management framework. GEF: US \$ 4.78 million; co-funding: US \$ 5.73 million; total: US \$ 10.51 million.

COMPONENT II: Joint Development and Implementation of the Guarani Aquifer System Management Framework

Component II is the core of the project and provides for an agreed technical, institutional, financial, and legal framework for management of the Guarani Aquifer System. Component II includes (i) harmonization and enhancement of data gathering networks, (ii) creation of a data management system serving the Guarani Aquifer System, (iii) development of joint institutional arrangements for the management of the Guarani Aquifer System, and (iv) formulation of strategic actions leading to the integration and optimization of development initiatives and proposals within the Guarani Aquifer System region. GEF: US \$ 3.60 million; co-funding: US \$ 3.54 million; total: US \$ 7.14 million.

COMPONENT III: Public and Stakeholder Participation, Education and Communication

Component III provides for the practical involvement of stakeholders in decision-making affecting the Guarani Aquifer System through both formal and informal educational and informational programming. A Guarani Aquifer System Citizens' Fund designed to provide cost-sharing funding to NGOs and academic institutions is an integral feature of this Component. GEF: US \$ 0.56 million; co-funding: US \$ 0.55 million; total: US \$ 1.11 million.

COMPONENT IV: Project Monitoring and Evaluation, and Dissemination of Project Results

Component IV consists of: (i) development agreed GEF-IW process, stress reduction, and environmental status indicators—comprised of goals, criteria, and standards, and implementation of a monitoring and evaluation system to track Project progress in addressing the abovementioned process, stress reduction, and environmental status indicators; and (ii) dissemination of project results within and outside of the Guarani Aquifer System region, including the implementation of measures for consultation and coordination between GEF-IW project managers working in the Latin American region. GEF: US \$ 0.48 million; co-funding: US \$ 0.27 million; total US \$ 0.75 million.

COMPONENT V: Development of Management and Mitigation Measures within Identified “Hot Spots”

Component V develops practical mechanisms and measures for the mitigation of current priority problems in 4 Hot Spots: (i) two identified transboundary localities within the Guarani Aquifer System area; (Argentina/Uruguay and Uruguay/Brazil); (ii) one recharge/discharge area of the Guarani Aquifer System (Paraguay); and (iii) a heavily urbanized area of the Guarani Aquifer System (Brazil), supporting ongoing mitigation and protection measures being undertaken by the Government of Brazil and State of São Paulo. The objective of Component V is to determine effective means and costs of quantifying, analyzing, managing, and remediating the impacts of known threats affecting specific, representative areas within the Guarani Aquifer System region. GEF: US \$ 2.18 million; co-funding: US \$ 1.32 million; total US \$ 3.50 million.

COMPONENT VI: Assessment of Geothermal Energy Potential

Component VI explores potential future geothermal energy uses of the Guarani Aquifer System. The objective of Component VI is to quantify and determine the potential value of the Guarani Aquifer System as a source of “clean” geothermal energy, and to communicate this assessment and appropriate guidelines with respect to sustainable development and utilization of any potential geothermal energy output of the Guarani Aquifer System to the respective stakeholders, including the energy ministries within the Guarani Aquifer System region. GEF: US \$ 0.21 million; co-funding: US \$ 0.04 million; total US \$ 0.25 million.

COMPONENT VII: Project Coordination and Management

Component VII supports project management and coordination. Component VII facilitates the liaison activities to be carried out by the Guarani Secretariat and the operational activities of the coordinating and executing units in the respective countries, as described in Section E.4. GEF: US \$ 1.59 million; co-funding: US \$ 1.91 million; total US \$ 3.50 million.

Table 2: Guarani Project costs and financing mechanisms

Component	Sector	Indicative Cost (US\$M)	% of Total	Co-financing (US\$M)	% of total financing	GEF Financing (US\$M)	% of total financing
1) Expansion of the Knowledge Base		10.51	39.3	5.05* 0.50** 0.14*** 0.03****	48.1 4.8 1.4 0.3	4.78	45.5
2) Development of a Joint Management Framework		7.14	26.7	3.33* 0.13*** 0.07****	46.6 1.9 1.0	3.60	50.5
3) Public and Stakeholder Participation		1.11	4.1	0.50* 0.048*****	45.0 4.3	0.56	50.6
4) Monitoring, Evaluation and Dissemination		0.75	2.8	0.27*	36.0	0.48	64.0
5) Development of Management and Mitigation Measures in Hot Spots		3.50	13.1	1.00* 0.32****	28.7 9.3	2.18	62.1
6) Assessment of Geothermal Energy Potentials		0.25	0.9	0.04*	1.1	0.21	85.0
7) Project Coordination and Management		3.50	13.1	1.91*	54.6	1.59	45.4
Total Cost of the Project		26.76	100.0	13.36	49.9	13.40	50.1

*Co-financing provided by the governments of the four participating countries

** Co-financing provided by the IAEA

***Co-financing provided by the BGR (still under discussion)

****Co-financing provided by the Netherlands-World Bank Water Partnership

*****Co-financing provided by Beneficiaries

2. Key policy and institutional reforms supported by the project:

The key policy and institutional reforms specifically sought with regard to the Guarani Aquifer System are: (i) recognition of the Guarani Aquifer System as a valuable transboundary resource; and (ii) creation of a framework for the shared management of the Guarani Aquifer System, including joint institutional-legal arrangements and data sharing. The proposed project would contribute to advancing policies relating to transboundary groundwaters in the four countries, especially with respect to an international transboundary legal and institutional framework that is currently lacking, and national groundwater institutional and legal frameworks that are rather disparate or missing. Specifically, the project will elaborate a Strategic Action Program encompassing, *inter alia*, a specific management and institutional framework for the Guarani Aquifer System. This framework could be expected to influence legislation regarding groundwater resources at the national level— and will eventually influence provincial or state levels, where applicable -- within the participating countries and give impetus to improved groundwater management generally. In developing the institutional framework the particular characteristics of the four countries' political organization will be taken into account.

3. Benefits and target population:

About 15 million people live in the Guarani Aquifer System region. While not all of these are supplied with Guarani Aquifer waters, increasing numbers of users can be anticipated to utilize this resource as a result of population growth and increased industrial consumption. This trend will be enhanced as a result of the increasing pollution of surface waters, which makes water from the Guarani Aquifer System more attractive. Therefore, target beneficiaries are the current and future populations within the Guarani Aquifer System region in the four countries.

In the long term, the expected benefits include: (i) a sustainable supply of safe water for human populations; (ii) high-quality water for industry; and (iii) a sustainable supply of thermal water for tourism, industrial, and municipal uses.

In the short and medium terms, beneficiaries also are the individuals and institutions who are active in the management of the Guarani Aquifer System. Through training and educational programs their capacity to contribute to the sustainable management of the Guarani Aquifer System will be greatly enhanced. The project is designed to internalize the experience generated by the project into the know-how of the four countries.

Global benefits to be derived from the improved management of the Guarani Aquifer System relate to the integrated management and use of this transboundary resource in a sustainable manner. Without this GEF-financed project, it is highly likely that the countries would not take measures at this stage to protect the transboundary water resources of the Guarani Aquifer System. Use of water resources at the national and sub-national levels would most likely continue until a crisis arises, at which point, the reversal of negative effects would be difficult and costly. Actions taken jointly at this stage by all four countries will provide a basis for considerable global (transboundary) benefit through effective pollution and overdrafting controls, especially in recharge and abstraction areas, and

improved land management, including, for instance, erosion control. In this regard, the development of specific, land use-related management and mitigation measures (through the targeted pilot demonstration projects), contributing to both global benefits and specific target groups, forms an important output of this project.

4. Institutional and implementation arrangements:

Given the multinational character of the proposed project, institutional and implementation arrangements were discussed in detail during project preparation. These are elaborated in Section E4. Since the project is intended to bring about significant institutional change (from the current lack of coordinated management of the Guarani Aquifer System to its sustainable long-term management), the future institutional arrangements to be developed as a component of this project are an essential element that will determine its long-term success. All the proposed activities will be driven by a Project Steering Committee (CSDP: *Consejo Superior de Direccion del Proyecto*), with coordination of the technical aspects of the project being provided by a Coordinating Council (CC: *Coordinacion Colegiada*). The day-to-day activities of the Project will be managed by the Guarani Secretariat (SG: *Secretaria General del Proyecto Sistema Acuifero Guarani*) under the direction of the OAS, with oversight from the CC. Activities within each country will be carried out by country-based project executing units (UNEP: *Unidad Nacional para la Ejecucion del Proyecto*), the heads of which (the four National Technical Coordinators, one from each country) will form the CC.

D. Project Rationale

1. Project alternatives considered and reasons for rejection:

Project alternatives considered were: (i) to do nothing (*laissez-faire*), or (ii) to carry out the project in only one or two countries. Alternative (i) was rejected due to the fact that the Guarani Aquifer System is clearly showing signs of initial stress. Thus, by taking preventive measures now, negative effects on groundwater quality and quantity can be mitigated and, perhaps, largely avoided. Given that groundwater pollution is very expensive and in some cases almost impossible to reverse, this opportunity to prevent damage to the aquifer obviates the do nothing alternative. By completing a relatively low-cost preventive project, embodied within a Strategic Action Program, the longer-term costs can be minimized in an effective manner. Similarly, groundwater overdrafting severely endangers any aquifer's sustainability, may reduce its capacities, affect present uses and restrain future developments as well. Again, a low-cost preventive water management framework, within the SAP, may prove to be crucial in solving or mitigating such problems. Likewise, Alternative (ii) was rejected because of the transboundary nature of the waterbody, which, by definition, implies that degradation of the resource in one country will have an impact on the other riparian countries. Agreements to preserve this type of waterbody need to be mutual and mutually enforced. Work within one or two countries to create a management system for the Guarani Aquifer System, therefore, was deemed to be suboptimal.

2. Major related projects financed by the Bank and/or other development agencies (completed, ongoing and planned).

Table 3: Major related projects financed by the World Bank and other agencies in Argentina, Brazil, Uruguay, and Paraguay

Sector Issue Project	Project	Latest Supervision (PSR) Ratings (Bank-financed projects only)	
		Implementation Progress (IP)	Development Objective (DO)
Bank-financed			
Irrigation	Uruguay Loan 3697: Irrigation and Natural Resources Project	S	S
Water Supply, Sanitation and Water Resources Management	Brazil Loan 3505 (Paraná): Water Quality and Pollution Control	S	S
Natural Resources Management	Paraguay Loan 3708: Natural Resource Management I	S	S
Water Supply and Sanitation	Paraguay Loans 4222 and 4223: 4th Rural Water Supply and Sanitation	S	S
Natural Resources Management	Paraguay – Mbaracayu Biodiversity (under preparation - no ratings available yet)	--	--
Natural Resources Management	Brazil Loan 4060: Rural Poverty – Paraná Land Management	S	S
Natural Resources Management	Brazil Loan 3160: Land Management II – Santa Catarina	S	S
Natural Resources Management	Brazil Loan 4148: Natural Resources Management	S	S
Other development agencies			
Transboundary Water Resources Management	Implementation of the Strategic Action Program for the Bermejo River Binational Basin (Argentina and Bolivia), GEF/OAS/UNEP	- -	- -
Transboundary Water Resources Management	Implementation of Integrated Watershed Management Practices for the Pantanal and Upper Paraguay River Basin, GEF/OAS/UNEP	- -	--

Transboundary Aquifer Research Project (includes Guarani Aquifer System)	UNESCO	--	--
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IP/DO Ratings: HS (Highly Satisfactory), S (Satisfactory), U (Unsatisfactory), HU (Highly Unsatisfactory)

3. Lessons learned and reflected in proposed project design:

The Project incorporates lessons learned in two strategic ways: first, by using experience gained in the water and related sectors within each of the four countries, and, second, by using the lessons learned by the World Bank and OAS with regard to GEF International Waters Projects.

National experience in the countries. Good institutional policies are essential to good water resources management, be they surface or ground waters. Experience in Brazil, particularly in recent years, has illustrated that policy dialogue is especially fruitful in the context of the preparation of specific projects (e.g., the Pollution Control Projects in Minas Gerais, Paraná and São Paulo, which have led to significant institutional change in each State; in Ceará where PROURB was a major catalyst in the implementation of the State's Water Resources Law; and in PROAGUA, which uses a two-tracked approach of demonstration projects and institutional change). Notwithstanding, groundwater has been largely neglected in all four countries, in spite of its overriding importance for water supply, especially in Uruguay and in certain regions of Argentina, Brazil and Paraguay. In Paraguay, the World Bank-financed 4th Water and Sanitation Project relies exclusively on groundwater. In this sense, the Guarani Project can have, and already has had, a catalytic effect on groundwater management in the countries in general. In this context, ongoing projects in the region and the furtherance of the sectoral dialogue on (ground)water resources management will be taken into consideration.

GEF International Waters Projects. A number of issues relating to GEF International Waters Projects were highlighted at two recent events: the World Bank stakeholder consultation held during June 2000, and the GEF International Waters Conference held during October 2000. The latter event included the then three GEF Implementing Agencies (IAs: the World Bank, United Nations Development Programme, and United Nations Environment Programme) as well as project staff and policy makers from around the world. The messages emerging from these events underlined the need for commitment from the countries and local demand for the project, both of which exist with respect to the proposed project. In addition, it was deemed essential that other agencies (multilateral and donors), having a stake or on-going projects in the region, be involved. In the case of the Guarani Project:

- the General Secretariat of the Organization of American States (OAS), which has been active as Executing Agency for UNEP-implemented GEF International Waters Projects, including projects on the Bermejo, Upper Paraguay, and San Juan River Basins, served as the executing agency for the preparation of this project;
- the United Nations Education, Scientific, and Cultural Organization (Unesco), under the auspices of their Transboundary Aquifer Project, participated in Guarani workshops during the project formulation period;

- the International Atomic Energy Agency (IAEA), which has previously been active in all of the four countries, will contribute to the geohydrological aspects of the Guarani Project at the invitation of the participating countries; and,
- the German Government, which has provided long-standing support to groundwater research in the Paraguayan Chaco and, recently, also in the Zona Oriental, is considering the provision of technical and institutional development assistance to the Paraguayan portion of the project through the German Geological Survey (*Bundesanstalt fuer Geowissenschaften und Rohstoffe*).

An important aspect of project design is the multilateral agreement on the institutional framework for the conduct of the transboundary waterbody project and Strategic Action Program formulation. Communication among the different parties is essential, and the project coordination units in each country (UNPPs: *Unidades Nacionales de Preparación del Proyecto*), created during project preparation, are proposed to be continued as a mechanism by which stakeholders from governments, subnational-level governments, and civil society (including NGOs and universities) will participate in the project. A number of workshops at both the national and regional level are included as a means of bringing together the actors from the four countries. The regional level meetings will be facilitated by the Project Steering Committee (CSDP: *Consejo Superior de Dirección del Proyecto*). Use will be made of World Bank multi-country video facilities, as a practical means of bringing stakeholders to the table without incurring high transaction and financial costs of international travel. The hitherto positive experience in this regard will continue to be reflected in the design of the institutional arrangements for project implementation.

GEF experience shows that reliance on heavy administrative structures for the management of GEF International Waters Projects is not necessary, and may even be counterproductive due to the elevated recurrent cost. In elaborating the institutional framework for the management of the Guarani Project, institutional arrangements have been designed to be as pragmatic and light as possible. To this end, the day-to-day execution of the project will be undertaken by a small but effective Guarani Secretariat, which will serve as the executive element of the CSDP and coordinate the activities carried out by the UNEPs (*Unidades Nacionales de Ejecución del Proyecto*).

The Project proposed herein also includes a number of pilot projects. Experience in other World Bank projects has shown that such projects, to serve their purpose, need good baseline data and well-designed monitoring and evaluation, and complementary Components to accommodate this need have been designed.

Finally, GEF experience has indicated that a significant lag time may occur between the preparation of the Strategic Action Program (SAP) and its implementation. For this reason, this project has been designed as the first phase of a larger Program for the Protection and Sustainable Management of the Guarani Aquifer System. Therefore, the elaboration of projects to implement the SAP will take place during the last year of the proposed project. Such implementation projects may be financed from a variety of sources, including national governments, the World Bank, other multilateral banks, and donors.

4. Indications of borrower and recipient commitment and ownership:

Annex 10 provides a list of the stakeholders that participated in the preparation of this project. Their participation is summarized below. (*For document to be submitted to GEF Council*: In addition, Letters of Endorsement of the project from the designated GEF country-based Focal Points are appended hereto as Annex 11).

National level. At the national level the project has received strong support from governmental institutions that have actively participated in project preparation activities and workshops. The Secretariat of Water Resources (SRH), Brazilian Ministry of Environment, sponsored, with its own resources, the meeting held in Foz do Iguaçu (Brazil), where the Guarani Project was first identified and discussed with the different partners as a project concept for GEF support. Subsequently, the Secretariat of Water Resources of Argentina, the National Hydrographic Directorate of Uruguay, and the Ministry of Energy and Mining and the Ministry of Public Works of Paraguay as well as the recently-created Paraguayan Ministry of Environment have sponsored project workshops in Santa Fé (Argentina), Asunción (Paraguay), and Salto (Uruguay), respectively. In addition, staff from all four countries have participated in project preparation activities. All four governments have created and staffed their respective project preparation units using local financial resources. Representation of the national governments in official meetings has been strong, including representation at the secretarial and ministerial levels. The preparation of the project, using PDF/B funds, received the full endorsement of the GEF focal points in all four countries during 2000 and, most recently, during March 2001 with respect to complementary PDF/B funding.

Subnational/non-governmental level. At the subnational and/or non-governmental levels, the project has received support from state governments in Brazil and provincial governments in Argentina (e.g., *inter alia*, the State of São Paulo, the State of Paraná, and the Province of Santa Fé). Strong support and full collaboration also has been forthcoming from the universities in the region (e.g., Universidad Nacional del Litoral and Universidad de Buenos Aires, Argentina; Universidade Federal do Paraná, Brazil; Universidad Nacional de Asunción, Paraguay; and Universidad de la República Oriental del Uruguay). Similarly, the project has been supported by a number of nongovernmental organizations (NGOs) that have been actively involved in the project preparation activities (e.g., Brazilian Groundwater Association - ABAS, Brazilian Water Resources Association - ABRH, among others). Information-sharing, collaboration, and involvement by large numbers of stakeholders (which have often exceeded all expectations) have generated many quality interventions and suggestions which have contributed to project preparation. Social interest and support for the project was equally high, as demonstrated by the large number of articles published in national magazines, newspapers and on-line within the region, and extensive number of special television reports. The high level of interest of stakeholders at the local level provides positive evidence of the commitment of the four governments at national and local levels. Awareness by all of the governments that transaction costs of this project are relatively high has not been a major obstacle to project preparation.

Supranational level. Both MERCOSUR—the Southern Common Market—through its Subgroup 6 (Environment), and the OAS, have supported project preparation.

5. Value added of Bank and Global support in this project:

The World Bank has operations and long-standing policy dialogues regarding different aspects of water management in each of the four countries. A large number of water projects have been implemented with World Bank support in the region. In Brazil, the World Bank has conducted an extensive review of the water resources, irrigation, and water supply and sanitation sectors, leading to the development of an integrated water supply and water resources management strategy for its operations in Brazil. Jointly with the Government of Argentina, the World Bank has recently completed a comprehensive review of the water sector, and the final report of this study is being disseminated. During 2001, the World Bank is conducting a similar comprehensive review of the water sector together with the Government of Uruguay. The combination of the sectoral knowledge of the World Bank and its experience in financing projects in the region is particularly supportive of this project.

The recent First Biennial GEF International Waters Conference, held in Budapest (Hungary) between October 14-18, 2000, demonstrated the World Bank to be a leading agency in implementing GEF International Waters Projects. Considerable in-house expertise and internationally-based knowledge of the main issues relating to such initiatives has been developed. Currently, the World Bank is involved in the implementation and/or preparation of some twenty-three GEF International Waters Projects in Latin America, Europe, Africa, South East Asia, and the Middle East. In addition, the World Bank is involved in fifteen other, related GEF projects dealing with coastal and marine issues, and nine aquatic biodiversity projects, having International Waters aspects.

Global support to the Project is essential due to the nature of transboundary waterbodies. The Guarani Aquifer System is unique in the world due to its size, good water quality, and thermal energy potential. The Guarani Aquifer System, therefore, constitutes an important strategic transboundary reserve in the region. Nevertheless, without global support for this project, short-term needs may supersede the strategic, integrated management of the resource, and the countries might decide to continue unilateral exploitation of the resource. To address this concern, GEF support, in this case, should focus primarily on the development and implementation of mechanisms and an institutional framework to prevent over-exploitation and degradation of this transboundary resource—the preventive focus of this project is unique within the GEF International Waters Program. In addition, this project would be the first groundwater project supported by the World Bank and GEF, further contributing to the global importance of this initiative.

E. Summary Project Analysis (Detailed analyses are in the project file; see Annex 9)

1. Economic (see Annex 4):

- Cost benefit NPV=US\$ million; ERR = % (see Annex 4)
- Cost effectiveness
- Incremental Cost
- Other (specify)

The economic evaluation methodology is the GEF incremental cost analysis. Although a number of baseline activities touch upon the proposed project, the incremental costs are substantial. Project investment will generate and bring together new data of interest to all four countries, and would put in place a joint institutional arrangement for aquifer management that would otherwise not exist. It is highly unlikely that the individual countries would take action independently to preserve a resource that will be available for other, neighboring countries to use. Thus, baseline investment is limited to some monitoring activities currently in place in Brazil and Uruguay, and nonpoint source pollution control activities and the implementation of groundwater legislation in Brazil.

The benefits to be expected from the project are of both a national and global nature, and mainly relate to the avoidance of future costs. Groundwater pollution is extremely costly and difficult to remediate. By putting in place a preventive mechanism, damage, and, thus, clean-up costs, can be avoided. A further benefit would be the preservation of a strategic reserve to supplement other water supply options within the region. This benefit is transboundary in that the preservation and rational use of the Guarani Aquifer System will preserve a multi-national natural resource for future generations, of apparently 'unlimited' quantity and high quality. Groundwater overdrafting effects are also extremely difficult to remediate. Implementing water management specific schemes as a preventive mechanism is very cost effective. It will contribute to preserve the Guarani Aquifer System as a strategic reserve, its benefits are of transboundary nature, helping preserve and rationalizing water abstractions from the Guarani Aquifer System. Although its actual capacity is currently unknown, the studies supported by this project will form the basis for establishing the capacity of the Guarani Aquifer System and rationally planning its future potential uses on a sustainable basis. Preliminary investigations suggest that, in the absence of the proposed project, the countries are not taking, or planning to take, any specific actions with regard to preservation of the Guarani Aquifer System.

All four countries currently benefit from its use. All four countries use its waters for human consumption. More than 300 cities use the Guarani Aquifer waters for domestic supply (Table 1). In this regard, the Uruguayan Water and Sanitation Agency (OSE) estimates, for example, that it is cheaper to pump clean Guarani Aquifer water from significant depths than to abstract and treat contaminated water from surface sources. It can be expected that, as other sources become more polluted, the Guarani Aquifer System will increasingly become the economically viable source of choice. Likewise, all four countries make limited use its waters for agricultural irrigation purposes. Uruguay also uses its thermal waters for tourism, and Argentina has recently started using its waters for the same purpose. As these uses intensify, conflicts are likely to result in the absence of an agreed transboundary water management framework. For example, the Uruguayan authorities have already expressed concern that the availability of thermal waters on the Uruguayan side may have been reduced since the opening of the Argentina thermal site. Most of the possible associated benefits, which might ultimately be found to be substantial, are considered to be incremental for the four countries, given the current state of knowledge of the Guarani Aquifer System.

2. Financial:

An important financial issue to be addressed is the sustainability of project intervention. While the project will have very limited infrastructure investments, a monitoring system and database will be designed and implemented. To be of use in the monitoring and management of the Guarani Aquifer System, the monitoring and management systems will have to be adequately maintained. In addition, it is anticipated that a long term coordinating mechanism, such as the proposed Guarani Secretariat, would be sustained. The recurrent cost of such a structure would have to be financed in a sustainable manner. To this end, Component II, Creation of a Joint Management Framework for the Guarani Aquifer System, includes a specific activity aimed at the definition of a sustainable financing mechanism for the long-term management of the Guarani Aquifer System, including consideration of water and concession fees.

Fiscal Impact:

The fiscal impact of the project is estimated as the cash contribution of the four countries to the project minus taxes. The total counterpart contributions by the countries to the project are estimated to be about US \$ 11.71 million, as both cash and in-kind contributions. Of these, US \$ 3.71 are taxes, leaving a total fiscal impact of US \$ 8 million assuming that also in-kind contribution are financed by the countries.

3. Technical: (see Annex 12: GEF STAP Review)

On the scientific and technical front, the activities and tasks selected are designed to generate that information regarded as essential to underpin effective groundwater management and to guide sustainable resource development and aquifer protection requirements. It must be recognized that some of this information is more efficiently acquired at local scale through pilot sub-projects (Component V), whilst other parts have to be generated at sub-regional (aquifer) scale (Component I). It will be essential to achieve a careful balance and close coordination between these two components. In addition, Component I is relatively large, containing numerous, closely-linked sub-components and tasks. These will require integrated planning and sensitive supervision by the Guarani Secretariat to ensure on-time completion of the main deliverables of these Components—key hydrogeological information and the numerical models of the Guarani Aquifer System—needed to formulate the Strategic Action Program and Management Framework.

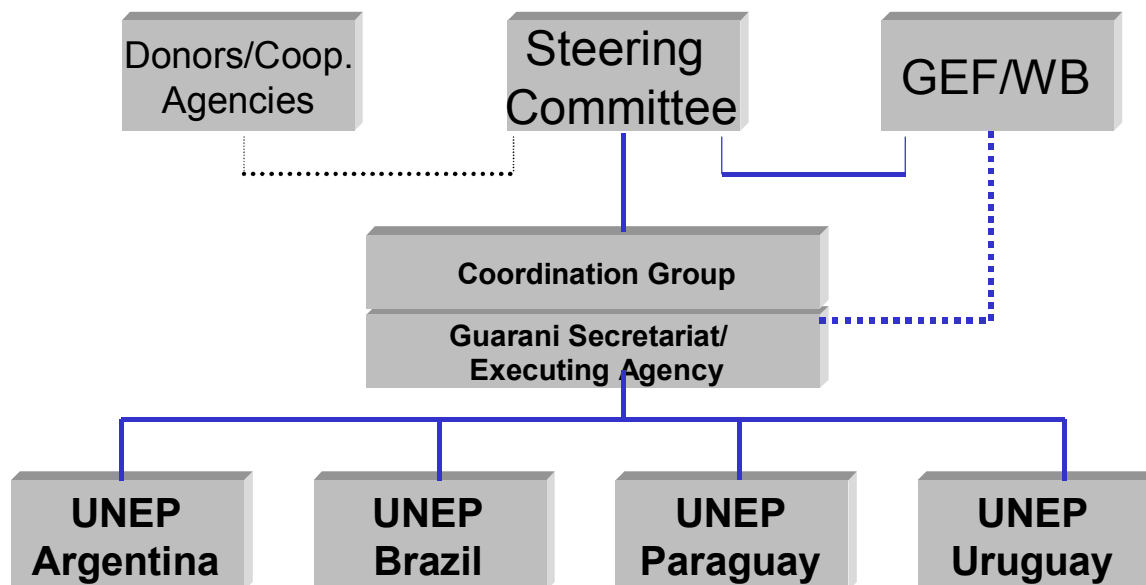
It is also important to recognize that groundwater investigations and development best proceed as a phased and iterative processes, and that close monitoring of aquifer response to water-supply development is normally the most cost-effective way of reducing uncertainty in numerical modeling of aquifers and groundwater resource estimation. Therefore, Components I and V are deliberately phased to allow an element of re-focusing and prioritization, in the light of the results generated during the first 18 to 24 months, at the time of the mid-project review.

4. Institutional:

A four-country, transboundary project has high transaction costs, and an appropriate mechanism for implementation is required. It is anticipated that the project will utilize a similar management mechanism to that employed during project preparation. For project preparation, one national project coordination unit (UNPP) was created in each country, supported by eight State-level units (UEPPs) in the case of Brazil. These Units functioned as technical entities. Overall policy-level decision-making was through the Steering Committee (CSPP), comprised of representatives of the respective national agencies with responsibility for water resources, foreign affairs, and environment, as well as representatives of the Organization of American States (OAS) and the World Bank. During the project preparation phase, the four countries indicated the OAS as the executing agency for the project, due to the multi-country character of the project. The OAS supported the project from its Washington Headquarters and through its country-based offices, as well as through contracted staff, including a Project Coordinator (*Secretario General*) and two technical staff, funded with GEF project preparation funds. The Government of Uruguay placed offices in Montevideo at the disposition of the project.

Since these arrangements worked well for project preparation, few changes will be made during project implementation. As shown diagrammatically below, the Project Steering Committee (CSDP: *Consejo Superior de Direccion del Proyecto*) is anticipated to have overall charge of the project, supported by a Coordination Group (CC: *Coordinacion Colegiada*) comprised of the four National Technical Coordinators appointed to head the four country-based Project Executing Units (UNEP: *Unidad Nacional para la Ejecucion del Proyecto*). This Coordination Group would provide oversight and direction to the Project Coordinator (*Secretario General*) and Guarani Secretariat (SG) staff, who would serve as liaison on a day-to-day basis between the UNEPs, the OAS and the World Bank.

A further institutional issue is the development of an operational institutional and legal framework for Guarani Aquifer System management. An operational institutional framework will be an output of the project. An appropriate process to arrive at a commonly agreed technical proposal for such a framework will be part of project documentation. Partners and countries are aware, however, that the final framework to be proposed would need to be light in order to be efficient and sustainable in the long run.



4.1 Executing agencies:

The OAS will be the Executing Agency for the project.¹ The OAS will act on behalf of the four countries, and be responsible to the World Bank (as Implementing Agency) and GEF to ensure that applicable rules and procedures are adhered to. In addition, the OAS will – with prior agreement by the CSDP – contract the Project Coordinator (*Secretario General*), the technical support team of three professionals, and an office manager to staff the Guarani Secretariat, and provide general administrative oversight.

In addition to the OAS, national (local) executing agencies will be confirmed in each of the four countries. The national executing agencies for the project will be the Subsecretariat for Water Resources in Argentina, the Secretariat for Water Resources in Brazil, the Secretariat for Environment in Paraguay, and the National Directorate for Hydrography in Uruguay. These local executing agencies will assist the National Technical Coordinators in the conduct of the project activities, and assist the national project executing units (UNEP: *Unidad Nacional para la Ejecucion del Proyecto*) through provision of office space and support services to the extent that these are required. Such support is considered within the counterpart contributions to the project. Representatives of the local executing agencies will also serve on the CSDP as indicated below.

4.2 Project management:

All the proposed activities will be driven by a Project Steering Committee (CSDP: *Consejo Superior de Direccion del Proyecto*). The Project Steering Committee will be comprised of

¹ A Procurement Assessment to this effect will be carried out by the World Bank.

four members from each country. These will be representatives of the respective national agencies with responsibility for foreign affairs, water resources, and environment. The fourth representative will be selected by the countries in order to adequately reflect the institutional set-up of each country. The four National Coordinators will participate *ex officio* in the meetings of the CSDP. In addition, one representative each of the World Bank and OAS may be invited to participate in meetings of the CSDP. The other GEF Implementing Agencies, and participating donor countries and agencies, will be informed of, and may participate in, meetings of the Project Steering Committee in an *ex officio* capacity. The Project Steering Committee will meet at least two times per year; the Committee may make use of the World Bank video-conferencing facilities for additional meetings as may be necessary. In addition, the CSDP may consider the formation of a Citizen Advisory Committee comprised of stakeholder representatives, NGOs and CSOs, as one means of encouraging broad-based community participation in the project as envisioned in Component III.

The technical program of the project will be supervised by a Coordination Group (CC: *Coordinacion Colegiada*) comprised of the four National Technical Coordinators appointed to head the four country-based Project Executing Units (UNEP: *Unidad Nacional para la Ejecucion del Proyecto*). This Coordination Group will provide oversight and technical direction, as agreed by the CSDP and through the work plans elaborated in the project operational program, to the Project Coordinator (*Secretario General*) and Guarani Secretariat (SG) staff, who will serve as liaison on a day-to-day basis between the UNEPs and the OAS and the World Bank.

A Guarani Secretariat, comprised of the General Secretary, technical staff members, their support staff, and the Executing Agency, will manage the day-to-day operations of the project, as agreed by the CC and elaborated in the project operational program. The General Secretary and Guarani Secretariat staff will be contracted by the OAS and will coordinate the conduct of project activities through the UNEPs. The Guarani Secretariat will endeavor to ensure the technical quality of the project, prepare project documents and reports, and support the monitoring and evaluation and reporting requirements of the World Bank. The Guarani Secretariat will also be responsible for drafting the TDA and SAP, with inputs from the UNEPs and project consultants. Further, the Guarani Secretariat will facilitate the flow of information and inputs from stakeholders with respect to the project at the regional level, and coordinate the activities of the Citizen Advisory Committee (if such a body is formed by the CSDP). In particular, the Guarani Secretariat will ensure that adequate attention is given to the views and concerns of indigenous community organizations and other CSOs active at the regional level. In addition, utilizing the IWRN and related mechanisms, the Guarani Secretariat will participate in regional communication and coordination opportunities among GEF-IW projects and programs being executed within the Latin American region.

Within each of the participating countries, a project executing unit (UNEP: *Unidad Nacional para la Ejecucion del Proyecto*) will be established by each country according to country priorities and rules. The national Technical Coordinator for each country will manage the activities of the project executing units in each country. These units will be responsible for recommending short-listed nominees for consultancies and the conduct of the project activities to the OAS. In addition, during project execution, the UNEPs will provide general

oversight and assistance to the consultants so as to facilitate on-time completion of project activities and the necessary degree of quality control/quality assurance with respect to the conduct of project tasks. The UNEPs will also facilitate the flow of information and inputs from stakeholders with respect to the project at the national and subnational levels. In particular, the UNEPs will ensure that adequate attention is given to the views and concerns of indigenous community organizations and other CSOs active at the national and subnational levels as envisioned in Component III of the project.

At the first meeting of the Project Steering Committee, the Project Steering Committee will adopt operating procedures for the conduct of Project Steering Committee meetings. The Project Steering Committee will agree administrative and reporting procedures consistent with World Bank standards and operating procedures as set forth in the Project Implementation Plan (PIP). Finally, the Project Steering Committee, at its inaugural meeting, shall conduct any other such business as may be required to initiate project Components, and set a date for the second meeting of the Project Steering Committee. Subsequent meetings of the Project Steering Committee shall be scheduled by the Project Steering Committee but shall be at least every six months during the project period.

Activities of national personnel, with the support of the national executing agencies, will be based upon preparatory work and Terms of Reference agreed with and approved by the Project Steering Committee, and consistent with the bidding and other procurement practices of the World Bank. The General Secretary and OAS will coordinate field activities, as directed by the Project Steering Committee and supported by the Guarani Secretariat. All project activities will be conducted within the Guarani Aquifer System area.

4.3 Procurement issues:

A procurement capacity assessment will be carried out by a Procurement Specialist of the World Bank prior to appraisal of the project by the World Bank.

4.4 Financial management issues:

A financial management assessment will be carried out by a World Bank Financial Management Specialist prior to appraisal of the project by the World Bank.

5. Environmental: Environmental Category: B

5.1 Summarize the steps undertaken for environmental assessment and EMP preparation (including consultation and disclosure) and the significant issues and their treatment emerging from this analysis.

This is an environmental project. The objective of the project is to ensure the sustainable management of the extensive Guarani Aquifer System. The project seeks to prevent the environmental damage, linked to groundwater pollution and depletion, that would otherwise come about because of poor knowledge and lack of policy coordination between the four countries (and their local governments) which share the aquifer. In addition to improving planning and policy formulation, the project supports specific environmental

protection measures, including: (i) improved control of water pollution (from point and nonpoint sources); and (ii) designation of critical groundwater recharge areas requiring conservation or other special management. Although some future uses of the water resources of the Guarani Aquifer System might involve adverse environmental impacts, the project would study these potential impacts and promote plans and policies to adequately control them. The project is expected to be highly positive from an environmental standpoint.

The project itself will not include any infrastructure investments. It may take advantage of some wells to be constructed by private or public utilities for other purposes. However, the location of any such wells to be used for project scientific purposes would be chosen in the context of promoting the environmentally sustainable use of the aquifer.

Likewise, Component VI is designed to assess the potential economic uses of the thermal waters of the Guarani Aquifer System. Depending upon the results of this assessment, concepts for future utilization of these thermal waters may be designed. The potential post-project development of thermal water resources might require mitigation of possible adverse environmental effects related to access road construction, thermal and chemical discharges, and noise. Additional measures to protect specialized aquatic biodiversity in thermal springs or pools may be required.

Key stakeholders—the national and sub-national governments in the four countries, the population in the Guarani Aquifer System region, local communities, NGOs, and academic institutions interested in sustainable groundwater use in the region—have been, and continue to be, involved in the project design and institutional arrangements for project implementation (see Section 6). Provision is made within the project management process to continue to engage key stakeholders in the SAP formulation process.

5.2 What are the main features of the EMP and are they adequate?

Prior to appraisal, an Environmental Analysis of this project will be prepared and incorporated into the PAD. This Analysis will include draft terms of reference for a Regional Environmental Assessment (REA) of thermal water development, which would be carried out as part of Component VI.

5.3 For Category A and B projects, timeline and status of EA:

Date of receipt of final draft:

5.4 How have stakeholders been consulted at the stage of (a) environmental screening and (b) draft EA report on the environmental impacts and proposed environment management plan? Describe mechanisms of consultation that were used and which groups were consulted?

Key stakeholders include: the national and sub-national governments of the four countries, the population in the Guarani Aquifer System region, farmers (from the perspective of the generation of nonpoint source pollution from agrochemicals), industries (from the perspective of the generation of point source pollution), water supply companies, local

communities, environmental NGOs, and academic institutions interested in groundwater management and research. These stakeholders were, and will continue to be, involved in the project through the appropriate design of institutional arrangements for project implementation.

5.5 What mechanisms have been established to monitor and evaluate the impact of the project on the environment? Do the indicators reflect the objectives and results of the EMP?

Component I of the project is designed to strengthen and harmonize the monitoring and information systems for the Guarani Aquifer System, including the creation of a shared data network between the four countries. The project itself is not expected to have an impact on the aquifer system, rather it is designed to provide the monitoring capacity (in technical, social and human resources terms) with which to assess the possible impacts of other activities on the environment. In addition, Component IV of the project is designed to provide for the monitoring and evaluation of project progress, and disseminate the results of the project.

With regard to the management and mitigation projects to be completed under Component V, the measures developed and implemented will have the objective of improving the management within specific, vulnerable local and sub-regional areas within the aquifer system. These measures will initiate a process of mitigating negative impacts from land use activities and industrial pollution. It will be important to monitor their effectiveness in order to determine if the measures developed and implemented are feasible and cost-effective, and worthy of dissemination more widely throughout the region. Monitoring systems, and appropriate indicators, to be developed under Components I, II, IV and V will contribute to this assessment activity.

6. Social: (see Annex 10: Public Involvement Plan Summary)

6.1 Summarize key social issues relevant to the project objectives, and specify the project's social development outcomes.

The primary aim of the project is to develop a sustainable management framework for the Guarani Aquifer System, given its importance as a water source for current and future generations. The social development outcome consists of preserving the natural resource base, rather than encouraging its immediate exploitation and use. Complementary interventions to improve soil and water utilization and management in its recharge areas, for example, will have relevance to the social development objective of benefiting local populations through these interventions. For these pilot projects, social assessments would be carried out as part of their preparation. Further, Component III is designed to provide a practical mechanism to develop, disseminate, and deliver appropriate informational programming to youth and communities to facilitate social communication, public participation and sustainable involvement in this project.

6.2 Participatory Approach: How are key stakeholders participating in the project?

Key stakeholders in the project are the national governments and sub-national entities in the four countries, universities, and local communities (especially in the pilot project areas). In terms of the institutional framework for project implementation, it will be important to ensure that key stakeholders have a voice. The conduct of frequent workshops is seen as an important means of bringing the different stakeholders together. Governments, through their relevant ministries and agencies, will continue to be represented on the Project Steering Committee and local executing agencies, while nongovernmental organizations and individuals will be integrated into the project through participation in the UNEPs and possible citizen advisory committees at national levels. (see point 6.3)

6.3 How does the project involve consultations or collaboration with NGOs or other civil society organizations?

Academic institutions and NGOs are involved in the project through their respective national coordinating units. Since they constitute a self-selected group of stakeholders, a number of workshops are proposed to be organized to bring together NGOs that are active in the water/environment nexus in the four countries. During project preparation, NGOs from the four countries were invited to an NGO-organized water event in Caxambú, Brazil, in order to receive information about the project and provide input to the project preparation process. The NGOs participating in this meeting were requested also to identify other NGOs that might be interested in the project. This was followed-up by a specific consultancy to identify key civil society stakeholders, as part of the project development activities. The stakeholder participation plan is appended hereto as Annex 10.

During the execution of the Project, provision has been made to engage key national stakeholders through their inclusion on a Citizens Advisory Committee to be convened by the SC at the regional level and replicated by the UNEPs at the national level. These fora are planned in order to receive specific input from the private sector, and to encourage and facilitate participation by, *inter alia*, indigenous community organizations. In addition, the inclusion of a special, small grants fund to support small projects related to the Guaraní Aquifer, to be implemented by NGOs, is included within Component III. Important activities in this regard would be community-based public education and awareness campaigns.

Key universities form an important nongovernmental constituency within the Guaraní Aquifer System region. The project concept initially was identified within the four countries by academic institutions. Due to their extensive research experience, these organizations are anticipated continue providing vital knowledge about the aquifer. It is anticipated that the components related to the expansion of the knowledge base, development of monitoring systems, and capacity building activities will strongly involve the academic community. The participation of the academic community in these portions of the project is critical to ensuring the sustainability of the project in the longer term, through their role in providing trained professionals to communities and the regulatory agencies within the region. Therefore it is expected that key universities, as well as other academic

and research institutions that have carried out investigations on the Guarani Aquifer System, will continue to be involved in the project during implementation.

Indigenous communities were specifically considered during project preparation following their expressed wish to be informed and incorporated into the project. A consultation process has been specifically designed into part of Component III to both inform indigenous groups in the Guarani Aquifer System region and seek appropriate mechanisms to best incorporate their voice and views into the project. Since the project does not include any investments, it would not have any physical impacts on indigenous communities. However, as a stakeholder group with an interest in the preservation of the Guarani Aquifer System, the project intends to ensure their adequate representation.

6.4 What institutional arrangements have been provided to ensure the project achieves its social development outcomes?

The implementation arrangements for the project include regular meetings of the project Steering Committee. These meetings are intended to provide the Governments, World Bank and other co-financiers with information on the progress of the project, and to provide them with the opportunity to modify project activities to best accomplish the overall project goals. As noted, one of these goals is community empowerment through appropriate informational programming, as embodied in Component III.

6.5 How will the project monitor performance in terms of social development outcomes?

Component IV is designed to provide information on project progress and success in achieving project outcomes through the regular and ongoing monitoring and evaluation of the project. The key performance indicators, set forth above, include an operational communications campaign designed to facilitate public involvement in the management of the Guarani Aquifer System.

7. Safeguard Policies:

7.1 Do any of the following safeguard policies apply to the project?

Table 4 presents a summary of the applicable World Bank policy safeguards.

Table 4: Applicability of the World Bank Policy Safeguards to the Guarani Aquifer System

Policy	Applicability
Environmental Assessment (OP 4.01, BP 4.01, GP 4.01)	● Yes ○ No
Natural habitats (OP 4.04, BP 4.04, GP 4.04)	○ Yes ● No
Forestry (OP 4.36, GP 4.36)	○ Yes ● No
Pest Management (OP 4.09)	○ Yes ● No
Cultural Property (OPN 11.03)	○ Yes ● No
Indigenous Peoples (OD 4.20)	● Yes ○ No
Involuntary Resettlement (OD 4.30)	○ Yes ● No
Safety of Dams (OP 4.37, BP 4.37)	○ Yes ● No
Projects in International Waters (OP 7.50, BP 7.50, GP 7.50)	● Yes ○ No
Projects in Disputed Areas (OP 7.60, BP 7.60, GP 7.60)	○ Yes ● No

7.2 Describe provisions made by the project to ensure compliance with applicable safeguard policies.

Safeguard policies which could potentially be applicable are: (i) environmental assessment; (ii) indigenous peoples; (iii) projects in international waters; (iv) involuntary resettlement; and (v) projects in disputed areas. Upon examination, the three first-named policies are applicable, as outlined below:

(i) Environmental assessment: As outlined in Section 5, the project aims to prevent future degradation of the Guarani Aquifer System through improved information, policies, planning, and development of specific pollution control measures. The project does not include infrastructure investments. However, the activities of Component VI might lead to post-project energy development or other thermal water use investments, which could have as yet unquantified environmental impacts requiring specific mitigation measures in the future. Accordingly, this project is classified as Category B.

(ii) Indigenous peoples: Given that the project area encompasses 1.2 million square kilometers, a number of indigenous groups living in the region are potentially affected by the project. The project will not have any infrastructure or investment components that would affect these indigenous groups. Some groups, however, have indicated their interest in being incorporated into project implementation as stakeholders. As part of the consultancies related to stakeholder identification and incorporation of stakeholders into project implementation, these groups will be taken into account. The principal indigenous peoples organizations will be specifically consulted during the project period, and specific recommendations on how to best incorporate indigenous peoples as stakeholders will be included in the SAP so as to ensure their adequate inclusion in the management of the Guarani Aquifer System.

(iii) International Waters: The guidelines referring to International Waters aim at identifying instances in which activities within a transboundary waterbody in one country would or could have effects on another country. In the case of this project the four riparian countries sharing the body of water are represented on the Project Steering Committee and have collectively submitted this project proposal. While the policy applies, separate notification of any one country is, therefore, not necessary.

(iv) Involuntary resettlement: Due to the nature of the project (e.g., involving no infrastructure investments), no involuntary resettlement will take place. Such wells as may be included within the project will be solely for research purposes, and the drilling sites would be chosen in such a manner that no involuntary resettlement was necessary.

(v) Disputed areas: There are no disputed areas in the project region.

F. Sustainability and Risks

1. Sustainability:

Sustainability of the project will be facilitated by involving stakeholders in the project activities from the beginning. As previously mentioned, the demand for this project originated in the countries. By building human capacities and strengthening institutions, and further sensitizing stakeholders, including those within civil society, it is expected that the collaborative framework built up by the project will be sustainable after the end of the project. Certain costs of the project, such as maintaining the information system, are of a recurrent nature and would require continuing financing by the governments and other stakeholders after project completion. These costs, including the costs of human resources and institutions, will have to be borne by the countries within the Guarani Aquifer System region.

As recently articulated at the previously referenced GEF first Biannual Conference on International Waters, the preparation of the Strategic Action Program, required by the GEF, constitutes the first phase of a project involving international (transboundary) waterbodies. It also implies that, in order to provide the project (and the process of better managing transboundary waters) with the necessary sustainability, a second phase needs be contemplated during which the Strategic Action Program would be implemented. As the Strategic Action Program is the principal output of this project, the need for follow-up will be taken into account by including planning for the second, implementation phase of the project into the last year of the current project. In the case of the Guarani Aquifer System, a second phase would imply investments in the protection of recharge areas, in the prevention and mitigation of point-source pollution, and in measures to reduce overdrafting of the Guarani Aquifer System in specific localities, as well as development of activities related to the thermal characteristics of its waters. Financing of the second phase might imply country resources, GEF, World Bank, and/or other multi- or bilateral funding.

2. Critical Risks (reflecting the failure of critical assumptions found in the fourth column of Annex 1):

Critical risks likely to influence the project outcome are summarized in Table 5. These risks reflect uncertainties identified within the Logical Framework Analysis set forth in Annex 1, and are generally related to the complexities involved in creating and implementing a joint management framework for the Guarani Aquifer System by the four countries sharing this transboundary water resource.

Table 5: Risks and mitigation measures associated with the proposed Guarani Aquifer System Project activities

Risk	Risk Rating	Risk Mitigation Measure
From Outputs to Objective		
Countries discontinue agreement to assess, create and share data about the aquifer; relevant data and information is not available or shared	N	Build a strong climate of collaboration through frequent and transparent communication during project preparation and implementation
Institutional arrangements cannot be agreed or do not function; compatible protocols, methodologies, processes and organizations fail to be agreed	M	Build a strong climate of collaboration through frequent and transparent communication during project preparation and implementation
Counterpart funding not available	M	Use discussions in Steering Committee to resolve issue
Capacity building measures do not produce quality contributions from all countries	M	Monitor quality of inputs from all four countries and strengthen where needed
Agreement on light and fair administrative structure for aquifer management cannot be reached	M	Start discussions early in the process and take into account interests of the four countries
Local stakeholders, communities (CSOs) and NGOs are not appropriately involved in project implementation	M	Disseminate information to civil society and design institutional arrangements to include organizations
Institutional roles not clarified or supported, politically or financially, especially at the sub-national government levels	M	Build a strong climate of collaboration through frequent and transparent communication during project preparation and implementation
Countries fail to carry out their obligations under regional agreements and plans	N	Use Steering Committee mechanism and communication to resolve
From Components to Outputs		
Collaboration between partners in the four countries weakens	M	Build a process of continued interaction as well as adequate monitoring of joint project results
Investigations are not carried out in a timely manner leading to partial slippage	M	Monitor input continuously and strengthen where needed
Governments and the public do not remain interested in broad participation in the project	N	Involve civil society from the beginning and inform them of options for participation to foster inclusion

Local interest in pilot measures is low; public does not participate in the project	N	Provide information to local stakeholders and incorporate concerns into design from beginning
Aquifer management system is not agreed or established	M	Build a strong climate of collaboration through frequent and transparent communication during project preparation and implementation
Timely follow-up is not achieved	M	Encourage local ownership of the project through workshops and seminars; prepare the implementation strategy during the project period and secure funding for implementation
Collaboration between partners, stakeholders, governmental units, and NGOs is not possible or fails	M	Disseminate information to civil society and design institutional arrangements to include organizations; build a strong climate of collaboration
Overall Risk Rating	M	

Risk Rating - H (High Risk), S (Substantial Risk), M (Modest Risk), N (Negligible or Low Risk)

3. Possible Controversial Aspects:

G. Main Conditions

1. Effectiveness Condition

tbd

2. Other [classify according to covenant types used in the Legal Agreements.]

tbd

H. Readiness for Implementation

- ☐ 1. a) The engineering design documents for the first year's activities are complete and ready for the start of project implementation.
- ☒ 1. b) Not applicable.
- ☐ 2. The procurement documents for the first year's activities are complete and ready for the start of project implementation.
- ☐ 3. The Project Implementation Plan has been appraised and found to be realistic and of satisfactory quality.
- ☐ 4. The following items are lacking and are discussed under loan conditions (Section G):
tbd

I. Compliance with Bank Policies

- ☐ 1. This project complies with all applicable Bank policies.
- ☐ 2. The following exceptions to Bank policies are recommended for approval. The project complies with all other applicable Bank policies. N/A

LIST OF ANNEXES

Annex 1: Project Design Summary (Logical Framework)

Annex 2: Detailed Project Description

Annex 3: Project Budget and Sources of Financing

Annex 4: Incremental Costs

Annex 5: Institutional Arrangements for Project Implementation

Annex 6: Description of the Guarani Aquifer System

Annex 7: Root Cause Analysis

Annex 8: Strategic Action Program

Annex 9: Available Reference Documents

Annex 10: Public Involvement Plan Summary

Annex 11: Letters of Endorsement

Annex 12: GEF STAP Review and IA Comments

Annex 13: Map

ANNEX 1: PROJECT DESIGN SUMMARY

I.1.1 LATIN AMERICA: Guaraní Aquifer Project - International Waters Mercosul

Hierarchy of Objectives	Key Performance Indicators	Monitoring & Evaluation	Critical Assumptions
<p>Sector-related CAS Goal :</p> <p>Improved groundwater resources management within the overall framework of improved water resources and natural resources management in the respective countries: Argentina, Brazil, Paraguay and Uruguay</p>	<p>Sector Indicators:</p> <p>Institutional and legal frameworks for groundwater resources management established and implemented</p> <p>Quality of polluted waterbodies improved or stabilized</p> <p>Groundwater overdraft mitigated or exploitation stabilized</p> <p>Water allocation efficiency, equitability, productivity and sustainability improved</p>	<p>Sector/ country reports:</p> <p>Benchmark reviews of Country Assistance Strategies</p> <p>Economic Sector Work in water, groundwater, and natural resources management</p> <p>Environmental analyses</p>	<p>(from Goal to Bank Mission)</p> <p>Enduring political commitment to improve water resources management and protection</p> <p>Enduring political commitment to take preventive measures for environmental sustainability</p>
<p>GEF Operational Program:</p> <p>Initiate actions toward resolving transboundary environmental concerns for the Guaraní Aquifer System within an improved joint groundwater management framework</p> <p>Derive lessons learned from experiences in using various types of institutional arrangements at the national and regional levels for collaboration in addressing priority transboundary environmental concerns</p>	<p>Transboundary environmental analysis carried out, identifying top-priority multi-country environmental concerns</p> <p>Strategic action program elaborated, consisting of expected baseline and additional actions needed to resolve transboundary concerns</p> <p>Lessons learned disseminated, monitoring systems developed and implemented, and positive improvements in process indicators, stress reduction indicators and environmental status indicators documented</p>	<p>Project reports and documents</p> <p>Monitoring and dissemination workshops</p> <p>Supervision missions</p> <p>Guaraní Secretariat/ Steering Committee reports and minutes</p>	<p>Political commitment among the four countries continues high</p> <p>Coordinated activities and joint efforts among the four countries are undertaken; Stakeholders are adequately involved in all countries</p>

Hierarchy of Objectives	Key Performance Indicators	Monitoring & Evaluation	Critical Assumptions
<p>Global Objective:</p> <p>Sustainable use and management of the Guarani Aquifer System in Argentina, Brazil, Paraguay and Uruguay for current and future generations, supported by the joint development and implementation of an adequate, functioning aquifer management framework, based on sustainable technical, scientific, institutional, legal, financial, political, and environmental grounds</p>	<p>Outcome / Impact Indicators:</p> <p>Pollution risks diminished or controlled</p> <p>Overdraft risks diminished or stabilized</p> <p>Risk of future inter-country groundwater conflicts diminished</p> <p>Future mitigation and stabilization costs reduced</p>	<p>Project reports:</p> <p>Strategic Action Program documentation</p> <p>Specific scientific, legal, technical, and institutional documentation</p> <p>Operational manuals</p> <p>Mid-term evaluation studies</p> <p>Periodic monitoring and evaluation system reports</p> <p>Opinion surveys</p>	<p>(From Objective to Goal)</p> <p>Continued political commitment by countries to agree on a common aquifer management framework</p> <p>Counterpart funding, sufficient financial resources available</p>
<p>Output from each Component:</p> <p>1. Expansion and consolidation of current scientific and technical knowledge base of the Guarani Aquifer System</p> <p>1.1 Thorough survey of all existing wells, public and private</p> <p>1.2 Geophysical / geological studies carried out and disseminated; geometric and structural features, including boundaries, are defined and made readily available to improve basic knowledge and enhance sustainable development of the aquifer</p>	<p>Output Indicators</p> <p>1.1.a) A database with integrated information readily available for water managers and for public informational use</p> <p>1.1.b) At least 70% of all wells assessed in terms of use and water availability, quantity, and quality</p> <p>1.2.a) Aquifer's western and southern limits defined; knowledge of boundary conditions improved</p> <p>1.2.b) A regional geological map, as well as specific maps on geometric features such as: isopachs, aquifer strata depths, general aquifer structural map including its main compartments, is produced</p> <p>1.2.c) A preliminary conceptual aquifer model is</p>	<p>Project reports:</p> <p>A periodic, basic Comprehensive Assessment Report on wells, their distribution and impacts</p> <p>Periodic publication of relevant maps and accompanying descriptive written and digital materials</p> <p>Published sampling, analytical, and quality control/quality assurance manual and reports</p> <p>Reports and proceedings from seminars and workshops</p> <p>Supervision / monitoring Reports</p> <p>Evaluation mission reports (mid-term evaluation)</p> <p>Periodic Technical Assistance visits and Reports</p> <p>Progress reports from the</p>	<p>(from Outputs to Objective)</p> <p>countries to assess, create, enhance, and share data and information</p> <p>Institutional arrangements between country and external</p> <p>Compatible protocols, processes, methodologies and organizations are being used</p> <p>Relevant data, information and documentation are readily available and shared</p> <p>Studies are adequately coordinated in terms of timing and mutual contributions</p> <p>Guarani Aquifer System Project coordinates well with contributing agencies staff, such as IAEA and BGR.</p>

<p>1.3 Hydrodynamic features of the aquifer are better defined to improve decision making on water allocation and protection; and the complex interactions between aquifer and surface waterbodies are gradually clarified, with special emphasis on recharge/discharge areas, particularly those related to wetlands and to sustainable development of the aquifer</p> <p>1.4 Water quality is assessed and pollution patterns distinguished in terms of the origin, impacts and ways to remediate the pollutants; specific isotope studies are carried out to support a better understanding on Guarani Aquifer System's origin and age, evolution, hydrodynamic behavior, boundary conditions, recharge-discharge relationships, and geothermal character</p>	<p>readily available to help improve understanding of its principal features</p> <p>1.3.a) A general, regional hydrogeologic map, as well as thematic maps on potentiometry with network flows, surveys of recharge and discharge areas, isotransmissivity and isoproductivity, is available</p> <p>1.4.a) Definition of specific areas with differential physical-chemical water quality of special interest such as areas of high salinity, high fluoride content, low enthalpy, and anthropogenic pollution</p> <p>1.4.b) Thematic Maps of isoconcentration lines and basic ionic relationships, as well as typical, descriptive hydrogeochemical diagrams such as Piper, Schöeller and Stiff, are available</p> <p>1.4.c) A comprehensive hydrochemical database is created and periodically updated to support further scientific and technical analysis, and to improve decision making on water allocation and protection</p> <p>1.4.d) At least 600 isotope analyses are carried out yearly with stable isotopes, and 500 specific isotope determinations and conclusions produced to improve understanding of the aquifer</p> <p>1.4.e) Two workshops on the isotope investigations held</p> <p>1.4.f) A specific module on isotope investigations of aquifers is included in the biennial Unesco (Montevideo) training</p>	<p>different UNEPs and the Guarani Secretariat</p> <p>Reports from participating agencies</p> <p>Guarani Aquifer Project Website</p> <p>Monitoring and Evaluation reports</p>	
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<p>2. Joint development and implementation of a Management Framework for the Guarani Aquifer System, including SAP</p> <p>2.1 Monitoring network for the aquifer system implemented, functioning and regularly assessed, to support scientific, technical and managerial activities regarding the protection and sustainable development of the Guarani Aquifer System</p> <p>2.2 Guarani Aquifer Comprehensive Geographic Information and Documentation System simultaneously implemented, shared, and regularly functioning in the four countries</p>	<p>2.1.a) Permanent monitoring network comprised of at least 184 wells (5% of total number of known wells) in place; adequate equipment, sampling procedures and frequencies, analytical methods, and sample management protocols are available</p> <p>2.1.b) Monitoring network and equipment set up, adequately maintained, and sustainably financed</p> <p>2.1.c) Samples taken periodically and analyzed with regard to pre-determined water quantity and quality parameters and performance indicators</p> <p>2.1.d) Information flow mechanisms, continuity procedures, and expansion provisions for future network improvement are available</p> <p>2.2.a) A highly efficient Information and Documentation System network implemented primarily via Internet, set up, and adequately operated and maintained with sustainable financing identified and available</p> <p>2.2.b) Wide-ranging scientific and technical information dissemination, and debate within discussion groups on pertinent topics via the project website</p>	<p>Periodic data reports and published information on the dimensions of the Guarani Aquifer System; supporting information published through Guarani Aquifer System (SISAG – Sistema de Información del Sistema Acuífero Guarani)</p> <p>Annual progress reports on progress toward formulation of the TDA and SAP, and the Guarani Aquifer System management framework</p> <p>Supervision/monitoring Reports</p> <p>Evaluation mission reports (mid-term)</p> <p>Periodic Technical Assistance visits and reports</p> <p>Progress reports from the Project Implementation Units according to institutional arrangements</p> <p>Assessment reports on the results of capacity building and institutional strengthening/twinning measures, donor/partner involvement, and distance education</p> <p>Guarani Aquifer Project Website</p> <p>Protocols for the operation and expansion of the GIS and web-based information systems implemented and sustained</p>	<p>Continued agreement by the four countries to jointly elaborate a Guarani Aquifer Management Framework and start parts of its implementation at a regional level</p> <p>Consensus among country governments and between these and civil society stakeholders</p> <p>Technical agreement can be reached on light and fair administrative structure for the Guarani Aquifer System</p> <p>CSOs are constructively participating in policy discussion and formulation</p> <p>Transboundary groundwater related institutional roles and responsibilities, with strong legal, political and financial support, are clarified at national, state / provincial / departmental levels, as applicable</p>
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<p>2.3 Multi-country institutional framework for long-term sustainable management of the Guarani Aquifer System established, with sufficient long term political and financial support agreed</p>	<p>2.3. a) Multi-country agreement on an institutional, financial, and technical framework to jointly manage the Guarani Aquifer System exists and is under implementation</p> <p>2.3.b) Specific support to water managers and strengthened institutional frameworks by means of consulting services on demand, technical exchanges, and twinned institutions</p> <p>2.3.c) At least 8 events – seminars, meetings, workshops – to be held to improve water management, with benefit to at least 25 organizations active in the groundwater field</p>	<p>An agreement or an intention protocol by the four countries as a paramount step toward a coordinated, sustainable management system for the aquifer</p> <p>Progress reports and minutes of the Steering Committee meetings and other diplomatic initiatives</p>	
<p>2.4 Strategic Action Program prepared, comprising at least plans for: (i) medium and long-term actions with regard to the management of the Guarani Aquifer System at the local, regional, national and supranational levels, (ii) investments for pollution and overdrafting prevention and mitigation measures, especially in transboundary problems, by public and/or private sectors, (iii) investments in geothermal energy use and other potential groundwater uses, (iv) and conflict resolution mechanisms</p>	<p>2.4 a) Documentation containing the Strategic Action Program for the four countries, including a Transboundary Diagnostic Analysis, legal and institutional frameworks, and accompanying material relevant to decision making such as regional mapping, diagrams and tables related to the state of the aquifer system</p> <p>2.4 b) At least 16 workshops and meetings held between stakeholders of multiple levels, nationally and internationally, to arrive at sustainable technical, scientific, legal, institutional and political – diplomatic agreements</p> <p>2.4.c) SAP formulated on a participatory and consensus basis, to support actions beyond the this first program phase, including identification of financing agencies and donors, and future information needs</p> <p>2.4.d) Technical consensus proposal for a Legal Framework to manage the Guarani Aquifer System elaborated</p>	<p>Monitoring and Evaluation Reports</p> <p>Strategic Action Program and Transboundary Diagnostic Analysis documents</p> <p>Legal proposal document</p>	

<p>3. Public and stakeholder participation, Education and Social Communication</p>	<p>2.4 e) Technical, scientific, legal, institutional and managerial capacity built in all four countries to adequately carry out strategic actions</p>	<p>Survey</p> <p>Supervision missions</p>	
<p>3.1 Public awareness among the population living in the Guarani Aquifer System region exists and gradually improves</p>	<p>3.1 a) Regional Public Communication and Participation Plans implemented and evaluated contributing to increased awareness and education of the population within the aquifer region</p> <p>3.1 b) 10% of the people in the aquifer region reached; their awareness of the Guarani Aquifer System existence and importance is raised and gradually improved</p> <p>3.1 c) Information dissemination campaigns carried out</p> <p>3.1 d) Information and document dissemination is continuously provided by the Guarani Aquifer Geographic Information System, especially via its Website</p>	<p>Supervision / monitoring reports</p> <p>Evaluation mission reports (mid-term and final)</p> <p>Periodic Technical Assistance visits and Reports</p> <p>Progress and Goal Achievement reports from the Project Implementation Units, according to institutional arrangements for the project</p> <p>Workshop reports</p> <p>Newspaper articles and TV / Radio coverage</p>	<p>Standardized criteria for Monitoring and Evaluation indicators are agreed with the four countries and being implemented</p> <p>Capacity-building measures and Technical Assistance</p> <p>Commitment remains high to integrate civil society into the process of designing a framework for the Guarani Aquifer System</p> <p>Each country carries out its campaigns according to agreed regional Plans</p>
<p>3.2 Participatory arrangements for civil society participation (NGOs, indigenous groups, private sector stakeholders, and the scientific community) in aquifer management agreed and implemented (<i>a strong interrelationship exists with component 5</i>)</p>	<p>3.2 a) Relevant civil society groups and organizations are granted participatory roles within Guarani advisory committees, according to institutional arrangements for the project</p> <p>3.2.b) Relevant stakeholders participate and commit in the Strategic Action Program formulation, including water users, water management institutions, water utilities and suppliers, NGOs, academic groups, individuals, private sector entrepreneurs, and minority groups such as indigenous communities</p> <p>3.2.c) Pertinent public communication materials produced to enhance</p>	<p>Manual on Regional and Local Social Communications published</p> <p>Environmental education materials published</p> <p>Specific project documents, papers and reports made available by specialized and nonspecialized regional and international magazines, and other brochures and informational materials published and distributed</p> <p>Guarani Aquifer Website</p> <p>Reports on public participation considered in the preparation of the legal framework</p>	<p>CSOs are interested in participating</p>

<p>4. Project monitoring and evaluation, and dissemination of project results</p>	<p>dissemination of information and knowledge about the Aquifer System and the project</p> <p>3.2 d) At least bi-annual workshops (by country) held for technical discussions, consultations and project progress information and feedback</p> <p>3.2 e) Private sector partners gradually increasing their participation and commitment with specific activities to develop and protect the Guarani Aquifer System</p> <p>3.2 f) The Fondo Guarani de la Ciudadanía established and US\$ 200,000 in grants awarded to CSOs</p>	<p>Guarani Aquifer System image library created and maintained on the website</p> <p>Regulations for the Guarani Aquifer System Citizens' Fund published and disseminated</p>	
	<p>4.1 Information is accessible in a timely manner to stakeholders in the four countries and other interested partners and parties</p> <p>4.1 a) Project monitoring and evaluation system is implemented and functioning</p> <p>4.1 b) Monitoring information and performance indicators assessed periodically according to predefined parameters and processes.</p> <p>4.1 c) Achievements are systematically evaluated</p> <p>4.1 d) At least four public monitoring workshops carried out</p> <p>4.1 e) Feedback and remedial actions taken if necessary</p> <p>4.2 Dissemination of project results</p> <p>4.3 Project results are internationally shared and validated</p>	<p>Supervision / monitoring reports</p> <p>Evaluation mission reports (mid-term)</p> <p>Periodic Technical Assistance visits and Reports</p> <p>Progress reports from the Project Implementation Units, according to institutional arrangements</p> <p>Monitoring and Evaluation reports</p> <p>Progress and Workshop reports</p> <p>Guarani Aquifer System Website</p> <p>Guarani Secretariat participates in regional GEF-IW meetings and events using the IWRN and other media</p>	<p>Sufficient capacity is created to enable high-quality monitoring, processing, evaluation and feedback of project results</p> <p>Healthy project performance helps keep counterpart funding available</p> <p>Stakeholders are flexible to adjust course if necessary, derived from periodic project assessments and feedback recommendations</p>

<p>5. Development of Management and Mitigation Measures within identified “Hot Spots”</p>	<p>4.3 b) Annual workshops held, from year 2 until project conclusion</p>		
<p>5.1 4 subregional areas of the aquifer system are defined in hydrogeological, socioeconomic, and environmental terms for piloting improved local and subregional groundwater management and public participation for aquifer protection and sustainable development</p>	<p>5.1.a) Stakeholder assessments carried out, including their interactions and information exchange, are implemented; local awareness raised; strong public participation and involvement in water resources management and decision making is fostered</p>	<p>Supervision / monitoring reports</p> <p>Periodic basic Comprehensive Assessment reports on the pilot demonstration projects</p> <p>Pilot project design and operation manual published</p>	<p>Local buy-in and active Participation, involvement and commitment</p> <p>Studies and analyses provide sufficient basis/background for the preparation of the pilots</p>
<p>5.2 Technical – scientific knowledge about the aquifer at the subregional and local levels updated, increased, strengthened and shared among neighboring countries in the shared pilot project areas</p>	<p>5.1.b) Institutions, users, and communities contribute jointly to improving the management of the aquifer under transboundary conditions within the pilot project areas</p> <p>5.2.a) Scientific studies executed within the pilot project areas to enrich knowledge of the aquifer and improve its management, as well as to help identify critical areas where existing groundwater related transboundary environmental problems are currently being mitigated or resolved</p>	<p>Field visits to pilot areas</p> <p>Evaluation mission reports (mid-term and final)</p> <p>Periodic Technical Assistance visits and reports</p> <p>Progress reports from the Project Implementation Unit</p> <p>Guarani Aquifer Website</p> <p>Periodic publication of relevant maps and accompanying descriptive written and digital materials</p> <p>Published sampling, analytical, and quality control/quality assurance manual and reports</p>	<p>Information is generated and improved, methodologies tested and results / conclusions at sub-regional level help improve joint development and implementation of water management framework</p> <p>Aquifer water management and protection experience and lessons learned are available for sharing and replication</p>
<p>5.3 At least 2 pilot management plans developed and under implementation</p>	<p>5.2.c) Geological, hydrogeological, and hydrogeochemical thematic maps, tables, and diagrams are readily available and periodically updated; data bases on wells, water uses, and aquifer parameters are available via SISAG and local information networks</p> <p>5.3.a) Specific subregional digital hydrogeological models are available to support decision making on water allocation, groundwater regulation, and dispute resolution among water users and institutions</p>	<p>Reports and proceedings of seminars and workshops</p> <p>Reports on the status, cost and feasibility of the various mitigation and management measures, including an assessment of public acceptance and participation</p> <p>Preparation and promulgation of local regulations for groundwater protection and management</p>	<p>Different partner agencies work together</p> <p>Collaboration across agencies exists</p>
		<p>Final assessment reports on the costs, feasibility, lessons learned, and recommended future actions published</p>	

<p>5.4) Implementation of a specific transboundary management framework to allowed testing and assessment of specific strategies, tools and actions to solve problems, utilize opportunities, and regionally replicate actions to help accomplish the overall project objective</p>	<p>5.3.b) Implementation of community communication programs to increase knowledge, interest, participation, and commitment of stakeholders in aquifer management</p> <p>5.4.a) Well permits and concessions assigned within a solid management framework; well and recharge protection areas created and enforced; subregional monitoring networks strengthened; vulnerability maps used as management tools; and minimum distance criteria for well construction and operation established</p> <p>5.4.b) At least 33% of all adults and 75% of students within the pilot project area are aware of ongoing actions and efforts related to the Aquifer and the Pilot Projects; at least one fourth of them have participated or are willing to participate in ongoing activities</p> <p>5.4.c) Replicable institutional, legal, managerial, social, and environmental experiences obtained in multinational transboundary groundwater management schemes</p> <p>5.4.d) Process and results documented and fed back into the overall Project</p>	<p>Land use and planning guidelines and ordinances at the local and subregional levels prepared and promulgated</p> <p>Monitoring and Evaluation Reports</p>	
<p>6. Assessment of Geothermal Energy Potential</p>			
<p>6.1 Aquifer's geothermal potential assessed in its geohydrological, socio-economic, and environmental dimensions</p>	<p>6.1 a) Geothermal data and pertinent information updated and new thematic maps produced (<i>in connection with Component I</i>)</p> <p>6.1 b) Four-country task force created to undertake scientific assessment jointly with international experts and agencies</p>	<p>Supervision / monitoring reports</p> <p>Evaluation mission reports (mid-term and final)</p> <p>Periodic Technical Assistance visits and reports</p> <p>Progress reports from the Project Implementation Unit</p> <p>Workshop reports</p> <p>Guarani Aquifer Website</p>	<p>Task force successfully Established and relevant stakeholders included</p> <p>Development possibilities derived from newly acquired information, methodologies and experiences, assessed in hydrogeological, socio-economic and environmental terms</p> <p>Development perspectives and guidelines available for future partners</p>
<p>6.2 Specific recommendations</p>	<p>6.2 a) Analyses of socio-</p>		

for activities to be executed in future endeavours, concrete proposals for possible geothermal development areas, and future geothermal project frameworks defined	<p>economic, financial, and environmental feasibility of possible future geothermal activities and areas carried out</p> <p>6.2 b) Conceptual identification of possible pilot projects as well as their prefeasibility in the four countries is available</p>	<p>Periodic publication of relevant maps and accompanying descriptive written and digital materials</p> <p>Compilation Report on all pertinent existing information and strategy definition with a local / subregional approach</p>	
7. Project Coordination and Management	Project well managed and objectives reached	<p>Project Progress Reports</p> <p>Supervision Missions</p> <p>Steering Committee meetings</p>	<p>Counterpart funding, including for country coordinators, is available</p> <p>Implementation arrangement adequately designed to deal with inherent project complexity due to the project's multinational character</p>

Project Components / Sub-components:	Inputs: (budget for each component)	Project reports:	(from Components to Outputs)
1. Expansion and consolidation of current scientific and technical knowledge base of the Guarani Aquifer System	US \$ 10.51 million		Collaboration between partners in the four countries remains high
2. Joint development and implementation of a Management Framework for the Guarani Aquifer System	US \$ 7.14 million		Research and development is carried out in a timely manner, with high quality and compatible methodologies Political commitment to the project remains high
3. Public and stakeholder participation, education and social communication	US \$ 1.11 million		Process to develop and implement the joint management framework is well designed and responds to stakeholders' needs
4. Project monitoring and evaluation and dissemination of project results	US \$ 0.75 million		Governments and the public remain interested in broad participation in the Guarani Aquifer System
5. Development of Management and Mitigation Measures within identified "Hot Spots"	US \$ 3.50 million		Aquifer System management definition and implementation Good baseline and timely follow-up
6. Assessment of Geothermal Energy Potential	US \$ 0.25 million		Local interest in measures is high and public involvement gradually grows
7. Project Coordination and Management	US \$ 3.50 million		Experience is increased and lessons learned are readily available for sharing and replication in similar projects
<i>Total project Cost</i>	US \$ 26.76 million		Partners from different sectors and origins, including water and energy, collaborate Rational implementation of potential uses promote better perspectives for future regional water resources development

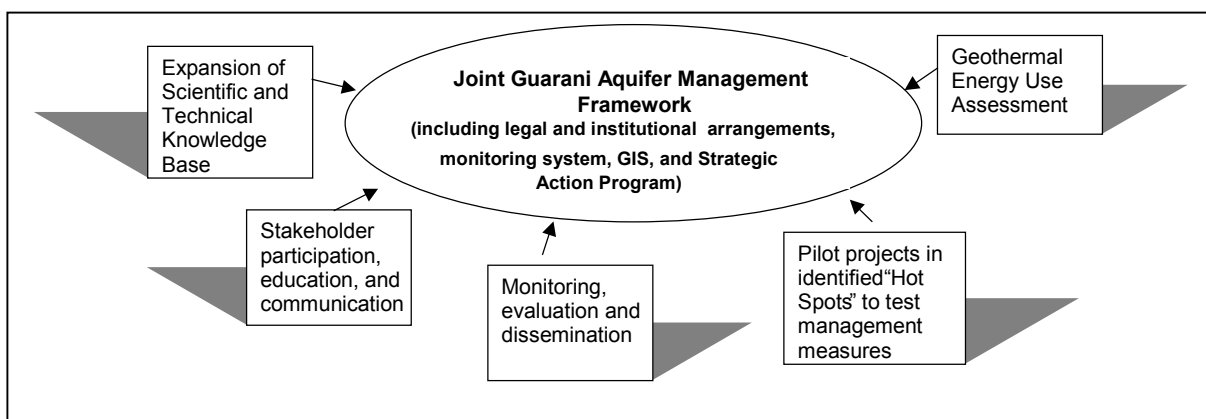
ANNEX 2: DETAILED PROJECT DESCRIPTION

1. Objective

The long-term objective of the process started through the proposed Project is the sustainable management and use of the Guarani Aquifer System. The Guarani Aquifer System is situated in the eastern and south central portions of South America, and underlies parts of Argentina, Brazil, Paraguay and Uruguay. This project is a first step toward achieving the long-term objective. The purpose of the proposed project is to support the four countries in jointly elaborating and implementing a common institutional, legal and technical framework for managing and preserving the Guarani Aquifer System for current and future generations. To achieve this, seven project components are envisaged: (i) expansion and consolidation of the current scientific knowledge base regarding the Guarani Aquifer System; (ii) joint development and implementation of a Guarani Aquifer System Management Framework, based upon an agreed Strategic Program of Action; (iii) enhancement of public and stakeholder participation, social communication and environmental education; (iv) evaluation and monitoring of the project and dissemination of project results; (v) development of regionally-appropriate groundwater management and mitigation measures in identified “Hot Spots”; (vi) consideration of the potential to utilize the Guarani Aquifer System’s “clean” geothermal energy; and, (vii) project coordination and management.

2. Approach

The joint development and implementation of the Guarani Aquifer Management Framework is the core of the Project. The other project components are designed to provide the scientific, technical, social, legal, institutional, financial and economic basis for the Framework, as illustrated in Figure 1. The proposed GEF project is comprised of six components, supported by a seventh administrative component. The specific objectives, estimated costs, and GEF financing for these seven components are briefly described below.



3. Project Components

The project has seven interrelated components that quantify the state of the aquifer in terms of its morphology and behavior, its use and conservation, its relationships to communities and institutions, and its planning and organizational needs for improving coordinated management of its waters. This knowledge will provide a scientifically-sound and well-documented base for establishing a framework for the coordinated and consensual management of the Guarani Aquifer System, capable of providing for the environmental protection, and integrated and sustainable development of the aquifer. The project will identify and test key management elements (including policies, mechanisms, and instruments) that will facilitate the sustainable and coordinated management of the Guarani Aquifer System. The resulting management framework will provide the means to mitigate and/or resolve the most pressing transboundary environmental problems that threaten the aquifer. In addition, this framework will provide a means to address local conflicts arising from the use of the waters of the aquifer system (especially those related to water pollution and over exploitation to provide a long-term strategy for risk mitigation), and assess its potential to provide “clean” geothermal energy to communities within the region.

COMPONENT I: Expansion and consolidation of the current scientific and technical knowledge base of the Guarani Aquifer System

The objective of this Component is to synthesize, analyze, and expand the existing knowledge base related to the Guarani Aquifer System in the four countries. A sound scientific and technical understanding of the aquifer is essential to the development of an articulated, consensual and effective management framework that facilitates the sustainable development of the aquifer within its regional setting, while providing a necessary measure of environmental protection for the shared resource. The Component will also seek to expand and improve the understanding of the potential and threats facing this body of water. In so doing, this Component will identify institutional actors, water users, and social groups whose actions impinge upon the Guarani Aquifer System. There are two sub-components:

1.a) Consolidation and expansion of the scientific knowledge base, in order to quantify and disseminate scientific knowledge on the geometry, structure and hydrodynamic behavior of the aquifer, and to synthesize and expand the existing knowledge base in order to meet specific objectives (including determination of the southern and western boundaries of the aquifer within Paraguay, Argentina and Uruguay) – A thorough inventory of public and private wells will be undertaken. The determination of the characteristics and magnitude of the Guarani Aquifer System, the extent of existing levels of pollution of the aquifer within the countries, and identification of the areas of recharge and discharge, including the hydrogeology and dynamics of the Guarani Aquifer System, are important, basic characteristics of the system that must be known prior to any attempt to manage the system.

1.b) Development of a suite of relevant groundwater models, accurately reflecting the characteristics of the aquifer – Based upon the knowledge base assembled during the previous sub-component, the technical knowledge of the Guarani Aquifer System will

be used to develop techniques to (i) conduct an appraisal of the present uses and anticipated future uses of the aquifer under a variety of foreseeable scenarios, (ii) assess the interactions between these various uses and the cumulative impact of the Guarani Aquifer System, and (iii) appraise the available technologies for surveying, extracting, and using the waters of the Guarani Aquifer System.

The results and products of the two sub-components will establish the parameters within which the Guarani Aquifer System can be sustainably exploited, without damage to the underlying structure and function of the aquifer system, within an objective technical and scientific framework. These results, in combination with the practical outcomes of the pilot projects in identified Hot Spots to be completed under Component V, are of fundamental importance for supporting decision making with respect to the management and protection of the Guarani Aquifer System.

The International Atomic Energy Agency (IAEA) will support a portion of this Component insofar as it relates to the application of isotope methodologies for determining, among other phenomena, the conditions and limits of groundwater flow within the Guarani Aquifer System. The IAEA will provide funds and in-kind support to the use of isotopes to delineate the extent and character of the aquifer, and, through these activities, contribute to building capacity and strengthening institutions in the countries in this region. The IAEA will also ensure the quality of the analyses and the consistency and reliability of laboratory results based upon the isotopes. Meetings are presently taking place to reach agreement on key points, with a view to specifying the level of support and commitments of the parties.

In addition, the Government of Paraguay is currently in discussion with the *Bundesanstalt fuer Geowissenschaften und Rohstoffe* (“German Geological Survey” – BGR) with regard to the provision of technical assistance in support of this Component. The BGR would provide in-kind support contributing to capacity building and institutional strengthening in Paraguay, and support the acquisition and management of geohydrological data within that portion of the aquifer.

GEF: US \$ 4.78 million; co-funding: US \$ 5.73 million; total: US \$ 10.51 million. Co-funding is expected to include contributions from the IAEA in the amount of US \$ 0.50 million, from the BGR in the amount of US \$ 0.14 million, and from the World Bank Netherlands Water Partnership Program (BNWPP) in the amount of US \$ 0.30 million.

COMPONENT II: Joint development and implementation of the Guarani Aquifer System Management Framework

As outlined in the introduction, this component constitutes the core of the project, with other components feeding into it. The objective of this component is to develop a framework for the coordinated management (technical, institutional, financial and legal) of the Guarani Aquifer System, taking into account the principles of sustainable integrated development, the problems and potential of the Guarani Aquifer System, and environmental protection concerns. This framework will be established within a Strategic Action Program (SAP) to be implemented in the Guarani Aquifer System region. The SAP will articulate, in a logical and comprehensive manner, in both space and time, the principal

lines of action necessary for achieving the project's long term objective. There are four sub-components:

2. a) Refinement and implementation of a monitoring network that provides results early in the execution phase to support efforts to implement and strengthen the knowledge base on the Guarani Aquifer System – This network is an essential tool for providing basic data and information necessary for the coordinated management and administration of the Guarani Aquifer System, and monitoring the behavior of the Guarani Aquifer System in space and time.

2. b) Development and integration of an Information System (SISAG - Sistema de Información del Acuífero Guaraní) for the Guarani Aquifer System that facilitates the management, standardization, dissemination, and utilization of data, information, and documents, in order to enhance coordinated management, based upon a sound knowledge of the Guarani Aquifer System – This system, including a GIS, will provide the technical basis for decision making relating to the aquifer. This system will provide the basic knowledge necessary for resolving present and emerging problems, and ensuring the sustainable use of the aquifer's potential.

2. c) Formulation of a Strategic Program of Action (SAP) – The SAP will provide a strategic framework for the coordinated management of the Guarani Aquifer System. Such a framework will facilitate and support solutions to the current and emerging problems of pollution and over-exploitation of the Guarani Aquifer System, as well as resolution of other transboundary environmental problems that may threaten its sustainable development.

A core piece of the SAP process will be to develop an institutional framework for the management of the Guarani Aquifer System. In addition, a sequence of activities is planned to arrive at a technically agreed consensus proposal for a legal Guarani Aquifer System management framework.

The SAP process also contributes to identifying and managing the potential uses of the Guarani Aquifer System through a process that encourages the participation of different stakeholders in the conduct of a prioritized, core group of activities for the coordinated management of the Guarani Aquifer System in a manner consistent with the purposes of the GEF and the interests of the four countries.

The SAP will enrich, diversify and disseminate knowledge, information, visions, and documentation on the Guarani Aquifer System, so as to promote sustainable, integrated management and environmental protection.

2. d) Improvement of institutional arrangements – Development of groundwater management expertise and strengthening the institutional base within the Guarani Aquifer System region is the basic building block upon which the transboundary management of the Guarani Aquifer System will be supported. Appropriate and relevant means of strengthening agencies, in order to support the management framework, to be further elaborated during the subsequent implementation phases of the

project, will promote a solid basis for the joint management of subterranean waters of the Guarani Aquifer System. These means include twinning arrangements between agencies involved in Guarani Aquifer System management in the different countries, a suite of groundwater management courses, short-term Technical Assistance, and study tours of managers and decision makers to other relevant transboundary (ground-)water institutions.

The mix of approaches adopted under this Component will not only contribute to the formulation of the SAP, but will also result in a comprehensive Transboundary Diagnostic Analysis (TDA) that represents the first step toward defining the underlying, root causes to be addressed during a program of active management of the aquifer. Given the technical capacities of the countries, it is important that the TDA be completed in such a way as to provide for the ongoing monitoring of the resource. This is particularly the case vis-à-vis the implementation of a monitoring system linked to an Information System, and the preparation and implementation of a shared GIS, which has been designed to support decision making for the management and protection of the Guarani Aquifer System. The Information System then becomes an essential element in the dissemination of knowledge on the aquifer and its different interrelationships. The nature of subterranean waters makes it possible to establish a monitoring system early on in the project. In addition, the volume and dispersion of the existing information on the aquifer requires a special informatics effort to organize and disseminate the information by means of a practical, operational information system during the early stages of project execution phase. By providing a working data and monitoring system early in the project, this Component can contribute to maintaining the interest of relevant groups of stakeholders.

GEF: US \$ 3.60 million; co-funding: US \$ 3.54 million; total: US \$ 7.14 million. Co-funding is expected to include contributions from the BGR in the amount of US \$ 0.13 million, and from the World Bank Netherlands Water Partnership Program (BNWPP) in the amount of US \$ 0.07 million.

COMPONENT III: Public and stakeholder participation, education and communication

The objective of this Component is to promote, support, and enrich the participation and involvement of the public, and to foster environmental and water education, social communication, and the dissemination of knowledge on the project and the Guarani Aquifer System, its management and conservation, within stakeholder communities. It includes strategies, programs, and actions, as well as support for the pilot projects in the identified Hot Spots to be conducted under Component V. This Component will involve: (i) the design and implementation of a Regional Communications Plan that will contribute to sensitizing and educating people in the Guarani Aquifer System region, and (ii) ensuring that relevant stakeholders are involved in preparing and executing the SAP. The stakeholders identified to date, through the project development phase activities, include water users, resource management institutions, water service providers in both rural and urban areas, NGOs, academics, the private sector, and minority groups. Three sub-components are proposed:

3. a) Preparation and implementation of a **Regional Communications and Public Participation Plan** – Periodic reviews of the status of information dissemination, and of the participation of the population in the region, including public servants, water users, academics, professional groups, business persons, indigenous groups and leaders, in developing and implementing the project, and in formulating the SAP will be undertaken. These reviews will contribute to an evaluation of results achieved at the end of the project in the areas of communications, education and public participation. A key element in achieving a high degree of public participation in the project will be the preparation of a Social Communications Manual for the project. The manual will outline ways and means of promoting events that will enhance the “image” of the project among stakeholder groups. It is anticipated that activities will include: the periodic preparation of an electronic “newsletter” to be distributed over Internet, targeting specific groups of stakeholders; circulation of an informational bulletin on the project, likewise over the Internet, as well as through other media; conduct of institutional-based information campaigns; design and implementation of a distance learning curriculum for youth, to be disseminated through radio/television and the press; and creation of a project image bank of digital photographs relating to aspects of aquifer protection and management.

3. b) Development of strategies and concrete actions for spurring and strengthening environmental education and education on the Guarani Aquifer System waters – **Community-level dissemination of information and knowledge** on the Guarani Aquifer System, its management and conservation, is an essential element for ensuring the sustainability of this project. Participation of community-based NGOs will be facilitated through a proposed Guarani Aquifer System **Citizens’ Fund**, the purpose of which is to support, in part, activities that encourage public participation, communication, and community education. This fund will be subject to implementation regulations that will govern the submission and funding of proposals from, *inter alia*, NGOs, community organizations, and universities operating in the Guarani Aquifer System region. It is anticipated that grants, up to US\$10,000 in value, will be awarded on a competitive basis, with a matching requirement of 20 percent applicant share and 80 percent Citizens’ Fund grant. The applicant share can be in-kind, with human resources valued at a standard rate to be determined as part of the grant regulations.

3. c) **Creation and dissemination of instruments to increase awareness, interest, and commitment among stakeholders** – Measures to involve children and youth in the Guarani Aquifer System project will not only enhance the project’s “corporate image”, but also result in a widespread and long term awareness and commitment to protecting and preserving the aquifer. Lessons learned from similar efforts within the Latin American region suggest that young people will carry the message of sustainable and responsible use of the aquifer from their classrooms to their homes, and that their parents will be engaged in the process of protection and sustainable utilization as a result. Thus, an important element of this sub-component will be development and dissemination of a school booklet and atlas of the aquifer. In addition, other activities envisioned include, *inter alia*, the preparation and dissemination of an environmental manual and a manual on the Guarani Aquifer System for teachers and community

leaders; sponsorship of contests and sports awards; conduct of radio and television campaigns; creation of reference centers and a mobile Guarani Aquifer System classroom; convening of workshops and seminars on the Guarani Aquifer System; and the production of supporting materials such as brochures, posters, and videos. Given the extent of the Guarani Aquifer System, these activities initially will be prepared as pilot demonstration projects, targeted to specific locations, which will facilitate testing of the materials and programs prior to later expansion to the regional level during subsequent phases of the project.

Specifically, the results of this Component will: (i) foster greater participation by interested parties in the project; (ii) expand the regional dissemination of knowledge on subterranean waters and the Guarani Aquifer System; (iii) enhance integration among project participants; (iv) produce promotional materials for disseminating information on the aquifer and the project; and (v) promote activities to awaken an interest in the economics of water and conservation of water quality. This Component will furnish the greatest number of people in the region—including minority cultures and groups—with information so as to promote their greater participation and involvement in the project. Stakeholder participation, especially in the formulation of the SAP, pilot projects in the Hot Spots, and the evaluation and monitoring of the project, will improve the likelihood of its sustainability.

GEF: US \$ 0.56 million; co-funding: US \$ 0.55 million; total: US \$ 1.11 million. Co-funding includes matching grants from beneficiaries representing US \$ 0.048 million.

COMPONENT IV: Project monitoring and evaluation, and dissemination of project results

The objective of this Component is to create and implement a system for recording and analyzing progress achieved during the project period. This system will allow early detection of potential problems, and provide feedback to the participants on the experiences gained and lessons learned. This Component will include the dissemination of information, results and lessons learned, with a view to possibly replicating project results under similar conditions and circumstances elsewhere in the Guarani Aquifer System region. It has three sub-components:

4. a) Development and implementation of a **monitoring, evaluation and feedback system** for the Guarani Project – Based upon agreed management and performance indicators that reflect the project objectives, consistent with the logical framework analysis (see Annex 1), periodic evaluations of project progress will be conducted by the Executing and Implementing Agencies. In addition, the Steering Committee, at its semi-annual meetings, will review the degree to which the project has fulfilled the key performance indicators. The Guarani Secretariat will also monitor project results on a regular basis. Goals, criteria and standards to measure and monitor project performance will be developed and agreed using the GEF-IW process indicators.

4. b) **Dissemination of project results throughout the region and beyond** – The results of the project and lessons learned will be disseminated through reports, the

Internet, international conferences, workshops and meetings, and direct exchange of experiences to other existing or potential groundwater management and protection projects. The Guarani Secretariat will act as a focal point for the interaction of the Guarani Project with other GEF-IW projects in the Latin American region. Using the IWRN and other media, the project staff will communicate and coordinate activities between GEF-IW projects to facilitate information-sharing and dissemination of project approaches and results.

Creation of capacity (human resources) within local and regional government institutions – In order to contribute to institutional development and to ensure widespread implementation of the lessons learned through the conduct of the Guarani Project, governmental stakeholders at the local and sub-national levels will be provided with specific information on the results of the project. In this way, the project will promote sustainable follow-up activities at the community level, and facilitate local ownership of the project findings.

The results of this Component will assist the Executing and Implementing Agencies to appropriately track project progress. This Component will also provide specific information to the Guarani Secretariat and project Steering Committee to facilitate their participation in the project and in ensuring the direction of the project, based upon regular reports and agreed progress indicators. Specific progress measures, in addition to the key performance indicators identified in the PAD and consistent with the GEF-IW process indicators, will be developed and agreed under this Component.

GEF: US \$ 0.48 million; co-funding: US \$ 0.27 million; total US \$ 0.75 million.

COMPONENT V: Development of management and mitigation measures within identified “Hot Spots”

The objective of this Component is to design, apply, and evaluate the costs and feasibility of good management practices at specific sites within the Guarani Aquifer System region. Appropriate management and mitigation measures to address specific threats facing the sustainable utilization of the Guarani Aquifer System will be developed for demonstration purposes. Dissemination of information on successful management and mitigation measures will be likely to spur concrete actions in areas currently under threat and/or where existing or emerging conflicts occur, especially in border areas. The pilot projects will focus on the prevention and mitigation of specific point and nonpoint sources of pollution, as well as overdrafting of the aquifer in critical recharge and discharge areas, or in confined areas of the aquifer, where there is a high concentration of uses and users.

It has been established through technical studies that clear transboundary issues exist in the border areas of Argentina/Uruguay (well yields are diminishing and some cross border disputes are apparent due to the importance of these geothermal wells for tourism) and Uruguay/Brazil (pollution between sister cities across the border). The nature of the aquifer system, i.e. very large volumes of mainly confined aquifer storage compared to significant – but smaller and much more localized – volumes of active recharge, mean that there is a possibility that major development could provoke large drawdowns with the potential for

conflict between competing users. This is the more significant, given the fact that the most valued exploitation is in the form of ‘overflowing geothermal wells’ and conservation of such artesian heads is managerially more demanding than normal aquifer management. Furthermore, the recharge area in Paraguay, bordering Brazil and Argentina, is a potential area for transboundary impact. These three areas have been included as Hot Spots with a transboundary focus to be addressed by the project.

In addition, the area of São Paulo is the one experiencing the most extraction and pollution in the entire aquifer system area. While it is highly unlikely that pollution in São Paulo would reach the other countries, the technical and institutional assessments have shown that this area can provide important lessons in terms of decentralized management and monitoring approaches. All four countries agree that the institutional management framework for the Guarani Aquifer System needs to be as light as possible, precisely due to its size. Therefore it will be necessary to test which types of measures will work in border areas and also in areas of significant national importance.

This component thus comprises two transboundary pilot projects associated with existing and emerging uses of groundwater, one border area pilot project associated with developing and understanding of aquifer characteristics, and one pilot project in a heavily urbanized area. In detail those are:

5. a) Concordia (Argentina) / Salto (Uruguay) – This area of the Guarani Aquifer System is currently experiencing concerns of a transboundary nature related to the exploitation of the waters of the Guarani Aquifer System for thermal tourism within a confined portion of the aquifer. This pilot demonstration project will develop a local understanding of the behavior and joint sustainable management of the thermal waters of the Guarani Aquifer System aimed at the sustainable utilization of these waters. (As noted elsewhere, this activity will also contribute to the studies and investigations proposed under Component I, and will also contribute to the assessment of the thermal energy potential of the Guarani Aquifer System waters to be conducted under Component VI).

5. b) Rivera (Uruguay) / Santana do Livramento (Brazil) – This transboundary demonstration project is designed to assess mechanisms relating to the management and protection of subterranean waters within an unconfined portion of the aquifer. Specifically, this sub-component will address the increasing concerns identified within geographic areas devoted to agricultural development and rural activities with relevant joint growth patterns observed during the past few years.

5. c) Eastern Paraguay – The border corridor between Paraguay and Brazil/Argentina is a recharge/discharge area of the Guarani Aquifer System. This Pilot Project will provide critical information regarding such areas in the Guarani Aquifer System and address concerns with regard to its vulnerability to human disturbance. The exact area will be defined by project start.

5. d) Ribeirão Preto (Brazil) – In addition to the foregoing, localized contamination and overdrafting of the aquifer from urban land uses in densely populated portions of the aquifer is another threat facing the Guarani Aquifer System. Strategic interventions in

the heavily urbanized area of Ribeirão Preto will be supported by the Project. They will leverage current activities by the Government of Brazil regarding groundwater protection and management measures in this area.

These sub-components will involve scientific and technical activities to clarify the hydrogeology, geophysics, hydrogeochemistry, and hydrodynamics of specific areas within the Guarani Aquifer System, and, in general, better define the morphology and dynamics of the Guarani Aquifer System at specific sites of critical importance. The selected, land use-related demonstration projects are strongly oriented toward identifying, implementing, and evaluating concrete and sustainable management measures relevant to the aquifer, and in resolving existing and potential transboundary environmental and water quantity threats as they apply to the Guarani Aquifer System. Thus, while these pilot projects include an element of local/subregional modeling, they focus primarily on the determination and implementation of measures to mitigate problems and sustainably tap the existing potential of the aquifer. The projects directly involve local stakeholders and interested parties in the assessment and decision-making pertaining to the management, administration, and local protection of the aquifer. The results of this Component will be tried and tested applications, procedures, methodologies, and legal and fiscal instruments, designed to meet the project objectives, that can be replicated elsewhere in the Guarani Aquifer System region or beyond where similar threats occur. The recharge/discharge area pilot project focuses more on developing an understanding of aquifer behavior in these critical areas, contributing basic information to, and complementing, the activities being conducted under Components I and II, and developing a methodology for assessing human impacts in these critical areas.

GEF: US \$ 2.18 million; co-funding: US \$ 1.32 million; total US \$ 3.50 million. Within the co-funding, a BGR contribution in the amount of US \$ 0.3 million is tentatively included.

COMPONENT VI: Assessment of Geothermal Energy Potential

The objective of this Component is to evaluate the geothermal potential of the Guarani Aquifer System in scientific, technical, economic, financial, and environmental terms, and to provide this evaluation to the relevant ministries, including energy, within the participating countries. The thermal waters of the aquifer are currently being exploited on a limited basis for thermal tourism, primarily in Uruguay and, to a lesser degree, Argentina. Favorable conditions for the occurrence of thermal waters are likely to exist in Paraguay and in certain places in Brazil. In addition to the use of these waters for thermal tourism, the possibility exists that these thermal waters could also be used in industrial processes and for the generation of energy as a substitute for fossil fuels. In particular, there is a clear interest in tapping the low enthalpy supply of the aquifer. However, given existing concerns regarding the sustainability of these thermal waters, the energy-related options will have to be evaluated in technical, economic, social, and environmental terms. Depending on the results of such an evaluation, pilot activities could be developed to make use of this potential, and perhaps spur the development of new projects that could be of interest to the countries. This Component has of two phases:

6. a) Phase one – During the first year of project execution, existing geohydrological data will be compiled and evaluated. Data to be used in the evaluation will be acquired under Component I of the project. These data will provide information on the extent of the thermal waters of the aquifer, and, through specific modeling activities, permit an assessment of the sustainability of proposals for exploiting such waters for geothermal energy production.

6. b) Phase two – During the second year of project execution, a task force comprised of representatives of the four countries, supported by world experts in the study and the use of the enthalpic energy, will be created. This task force will conduct a scientific evaluation of the geothermal potential of the Guarani Aquifer System based upon the data acquired during Phase one. The task force also will evaluate the technical feasibility of using geothermal energy, conduct financial and economic analyses based on economic and environmental impact studies of possible future energy production activities, and, depending upon the outcome of these actions, and taking into account technical, economic and environmental considerations, identify and prioritize areas for possible geothermal development. This latter activity, the results of which will be communicated to the energy ministries in the participating countries, will include specific recommendations for future works and the preparation of thermal projects at the conceptual level in the four countries, insofar as they are likely to be sustainable.

The results of the Component will be specific recommendations for future works, including proposed areas for possible geothermal development, and concept level proposals for the formulation of such projects. These results, together with the appropriate guidelines to be developed as part of the SAP, will be shared with the energy ministries of the participating countries and used to guide decision-making with respect to the future development of this potential. Based upon these results and recommendations of the task force, each country will be able to consider what steps to take to further develop identified potentials, including undertaking pilot projects in their territory should the results warrant.

GEF: US \$ 0.21 million; co-funding: US \$ 0.04 million; total US \$ 0.25 million.

COMPONENT VII: Project coordination and management

The objective of this Component is to provide organizational and administrative support to the project. This Component will include the incremental elements of activities associated with project leadership and coordination within the regional context, together with analytical capacity and production of specific material and documents. As noted under Component IV, the Guarani Secretariat will act as a focal point for the dissemination of project results, and coordination with, and communication between, other GEF-IW projects within the Latin American region. The IWRN and related communication media and mechanisms will be utilized to facilitate this interaction.

The results of this Component will be an agreed framework within which the institutional arrangements and agreements to sustainably manage the Guarani Aquifer System can be completed.

GEF: US \$ 1.59 million; co-funding: US \$ 1.91 million; total US \$ 3.50 million.

ANNEX 3: Project Budget and Sources of Financing

Project Budget and Sources of Financing

	External Contribution (US\$ x 1000)						Countries' Contribution (US\$ x1000)					
	GEF		Other Sources ¹		Subtotal		Uruguay	Argentina	Brasil	Paraguay	Subtotal	
	Amount	%	Amount	%	Amount	%					Amount	%
A. Expansion and Consolidation of the Current Scientific and Technical Knowledge Base of the Guarani Aquifer System	4778.2	45.5	675.5	6.4	5453.7	51.9	677.5	1173.7	2518.8	682.2	5052.2	48.1
B. Joint Development and Impl. of a Mngmt. Framework	3604.5	50.5	206.6	2.9	3,811.1	53.4	418.6	526.7	2003.5	381.1	3,329.9	46.6
C. Public Participation and Communication	560.8	50.6	48.0	4.3	608.8	55.0	47.7	117.2	260.3	73.8	499.0	45.0
D. Project Monitoring, Evaluation and Dissemination	479.9	64.0	-	-	479.9	64.0	143.5	22.8	86.8	17.4	270.4	36.0
E. Pollution Control and Mitigation Pilots	2,175.6	62.1	324.4	9.3	2,500.0	71.3	422.2	210.5	331.6	40.1	1,004.3	28.7
F. Development of Geothermal Energy Potentials	213.3	85.0	-	-	213.3	85.0	-	12.5	18.8	6.3	37.6	15.0
G. Project Management	1,588.6	45.4	-	-	1,588.6	45.4	367.9	524.0	593.7	422.0	1,907.6	54.6
TOTAL	13,400.9	50.1	1,254.5	4.7	14,655.5	54.8	2,077.4	2,587.4	5,813.5	1,622.9	12,101.1	45.2

¹ Contributions by IAEA, BGR, Beneficiaries and WB/Netherlands Water Partnership Program

ANNEX 4: INCREMENTAL COSTS

1. Broad Development Goals The long-term objective is the sustainable management and use of the Guarani Aquifer System. The Guarani Aquifer System is situated in the eastern and south central portions of South America, and underlies parts of Argentina, Brazil, Paraguay, and Uruguay. This project is a first step toward achieving the long-term objective. The purpose of the proposed project is to support the four countries in jointly elaborating and implementing a common institutional and technical framework for managing and preserving the Guarani Aquifer System for current and future generations. To achieve this purpose, seven project components are envisaged: (i) expansion and consolidation of the current scientific knowledge base regarding the Guarani Aquifer System; (ii) joint development and implementation of a Guarani Aquifer System Management Framework, based upon an agreed Strategic Program of Action; (iii) enhancement of public and stakeholder participation, social communication and environmental education; (iv) evaluation and monitoring of the project and dissemination of project results; (v) development of regionally-appropriate groundwater management and mitigation measures in identified “Hot Spots”; (vi) consideration of the potential to utilize the Guarani Aquifer System’s “clean” geothermal energy; and, (vii) project coordination and management.

2. Baseline Situation. Relatively few investments have been made to date in the project area and surrounding environs. Notwithstanding, the countries have acknowledged the increasing pressures upon the Guarani Aquifer System, and have recently increased their levels of investment in this system. These consist of: (1) ongoing and long term development projects for the lands overlying the Guarani Aquifer System, and (2) environmentally related activities associated with development programs or executed independently by federal/national, state/provincial, and local authorities. Most of the projects tend to be within the latter category of investment, and are almost exclusively financed by national agencies. These agencies include the Subsecretariats for Water Resources, for Planning and Social Environment, and for Environment, provincial directorates for public works and water/water resources, and universities in Argentina. In Brazil, these agencies include various national institutes, corporations and universities, the Secretariat for Water Resources, and the National Water Agency, and state directorates for water and environment. In Paraguay, the agencies include the Secretariat for Environment, the National Environmental Health Service, the Asuncion Sanitation Corporation, and the national university. In Uruguay, these agencies include the National Directorates for Hydrography, for Minerals and Geology, and for Environment, the National Sanitation Administration, and national university. The studies undertaken by these agencies are almost exclusively aimed at data acquisition for specific research projects, are largely uncoordinated, and are designed to fulfill specific national or local purposes. While many of these projects are relatively uncoordinated, it is anticipated that direct benefits for the formulation of the Strategic Action Program (SAP) can be realized during the conduct of this project. Therefore, these investments represent viable in-country programs and activities within the region that may have impacts on the project activities.

3. Other baseline activities, which have largely domestic or local impacts, include local development and water supply works being conducted by the federal and national governments, provinces, states, and local governments within the region. Notwithstanding, data gathered under these programs will be available to, and used in, the preparation of the SAP to address environmental and developmental concerns within the Guarani Aquifer System region. With the exception of the harmonization of the hydrogeological monitoring network and other coordination activities noted above, no additional efforts are proposed. Conservatively, these costs have not been considered *in extenso* in the calculations presented in Table 7.

4. GEF Alternative Scenario. The alternative scenario consists of the implementation of those actions needed to both introduce the principles of environmentally friendly management and sustainable development into development projects in the Guarani Aquifer System region. These actions are designed to achieve global/transboundary environmental benefits by providing a framework for the sustainable development and management of groundwater resources, and by addressing transboundary concerns identified through a rigorous program of data gathering and analysis. The elements of this program will be transferable to similar situations worldwide. The costs of the actions are those necessary to include sustainable development considerations into development projects within the region over and above the requirements of the regular environmental impact assessments and mitigation measures required to be completed under existing national, federal, provincial and state environmental laws and regulations.

5. Water resources management in the Guarani Aquifer System basin will be directed and coordinated by the relevant national and federal agencies, as set forth in specific national and federal laws. Harmonization and compatibilization of these legal systems, and existing national and federal programs, in the context of the Guarani Aquifer System is an important element of this project. To achieve this result, the agencies managing the water resources of the Guarani Aquifer System, *inter alia*, will require strengthening both in terms of institutional functioning and human resource capacity.

6. Reduced contamination, improved public health, and more effective and sustainable use of available water resources are national benefits to be expected as a result of the activities of this project. Notwithstanding, these outcomes also have significant impacts in maintaining the Guarani Aquifer System and, therefore, have additional benefit for the globally significant resources within the region. However, the full extent of localized benefits cannot be estimated at this time. Thus, it is assumed that the domestic funding provided is equivalent to the national costs and will adequately compensate for the domestic benefits achieved.

7. Global Benefits. The global benefit arising from the GEF intervention will be the formulation of a comprehensive management program to reduce contamination and pollution that will not only have significant human benefit in the surrounding countries, but also could have benefit to regionally significant wetlands, coastal areas, and riverine systems. A strategic program of activities will be conducted within the Guarani Aquifer System region, which will demonstrate an approach to groundwater management that could reduce contamination, minimize overconsumption, and promote sustainable utilization of

groundwater systems worldwide. A breakdown of expected global benefits, by component, follows.

Component I, Expansion and Consolidation of the Current Knowledge Base. The activities set forth under this component are designed to assess and quantify specific issues of concern within the Guarani Aquifer System basin identified during the GEF-PDF activities. These issues, to be quantified within a Transboundary Diagnostic Analysis (TDA), include the identification of the actual extent and geology of the Guarani Aquifer System; the quality of the waters contained within the Guarani Aquifer System; aspects of the hydrology, recharge and utilization of the waters of the Guarani Aquifer System; and the development of a model or suite of models, to be used in the management of the resource, that describe the Guarani Aquifer System. The proposed project considers means for identifying and quantifying risks of contamination and overuse of the Guarani Aquifer System, known to be currently occurring. The baseline costs cover existing infrastructure, monitoring activities, and investments in the Guarani Aquifer System region, as well as the estimated US \$ 5.73 million counterpart contributions from the national and federal governments, and local governmental and nongovernmental (NGOs) organizations, including educational institutions. The alternative project costs are US \$ 10.51 million. GEF incremental funding is US \$ 4.78 million.

Component II, Joint Development and Implementation of a Guarani Aquifer System Management Framework. The rational use of water and other natural resources within the Guarani Aquifer System region is limited by several existing and potential uses of water within the region that are competing for increased shares of groundwater. This competition can influence the quality and quantity of groundwater as well as potentially influence ecosystem structure and functioning where the groundwater system interacts with the land surface. Given the intensity of existing and potential demands upon this system, development of an integrated program of water resource management could provide for a significant improvement in the decision-making ability of regulatory agencies in the region that would result in both global and domestic benefits. Such an improvement would contribute to achievement of an optimal mix of different groundwater uses, based upon the corresponding costs and benefits of each use, including, *inter alia*, environmental uses, which could support negotiated allocations among the different stakeholders and related water pricing decisions. Knowledge of the critical factors influencing groundwater behavior, and experience with methods of negotiation and agreement among competitive users of water, to be acquired under Components I, III, and V, as well as elements of this Component, will be used for improving management of natural resources in the basin. This management framework could be transferred to other international groundwater systems where complex mixes of competitive water uses exist. The baseline cost of this Component is US \$ 3.54 million, representing investments in operating the existing geohydrometeorological networks and other counterpart government contributions. The alternative project cost is US \$ 7.14 million. GEF incremental funding is US \$ 3.60 million.

Component III, Public and Stakeholder Participation. The baseline costs of this component represent completed and ongoing activities by the governments, provinces, and states for engaging a variety of stakeholders in the design and implementation of on-the-ground management activities. The national, federal, and local governments, and NGOs, will

contribute US \$ 0.55 million to cover ongoing educational and information programming within the Guarani Aquifer System region. The alternative project cost is US \$ 1.11 million. The actions proposed to be undertaken will expand and enhance public involvement and stakeholder participation, including indigenous groups, through broadly-based formal, institution-based as well as informal, community-based educational and informational opportunities. GEF incremental funding is US \$ 0.56 million.

Component IV, Project Monitoring and Evaluation, and Dissemination of Results. Together with the monitoring and management activities set forth in Components I through III, this Component will strengthen institutional capacities to monitor and manage the groundwater resources of the Guarani Aquifer System, to increase and enhance the human resource capabilities necessary to carry out a program of strategic activities within the Guarani Aquifer System region, and reinforce the capacities of the institutions working in the Guarani Aquifer System region to collaborate in data-sharing and analytical activities essential for the sustainable, shared utilization of the resource. The baseline cost of this Component is US \$ 0.27 million. The alternative project cost is US \$ 0.75 million. GEF incremental funding is US \$ 0.48 million.

Component V, Development of Management and Mitigation Measures. Based upon information gathered during the GEF-PDF activities, together with the monitoring and management activities set forth in Components I through III, this Component will result in the development of measures to quantify, analyze, and mitigate the impacts of human use of the Guarani Aquifer System in up to four specific geographic areas overlying the aquifer. These areas represent current occurrences of groundwater management issues of concern that are likely to recur within the Guarani Aquifer System basin; namely, areas of exploitation of the aquifer for geothermal water use, for urban and industrial water use, and for agricultural water use, and areas of overexploitation of groundwater resources. The project will focus on two transboundary areas, one vulnerable recharge and discharge area in Paraguay and one heavily urbanized area in Brazil. The baseline cost of this Component is US \$ 1.32 million. The alternative project cost is US \$ 3.50 million. GEF incremental funding is US \$ 2.18 million.

Component VI, Assessment of Geothermal Energy Potential. This Component is designed to assess the potential utilization of the Guarani Aquifer System for geothermal energy production. Such utilization is an emerging use that has the potential to conflict with the current use of these waters for tourism. Nevertheless, geothermal energy production has the potential to provide a source of “clean energy”, which is, as yet, undeveloped and underutilized. The baseline cost of this Component is minimal, US \$ 0.04 million, given the limited current usage of geothermal energy potentials. The alternative project cost, to consider the future utilization of this energy source, is US \$ 0.25 million. GEF incremental funding is US \$ 0.21 million.

Component VII, Project Coordination and Management. In order to ensure a coordinated and focused approach to the conduct of this project, this Component provides incremental funding for the management activities of the Guarani Secretariat and national executing agencies responsible for the day-to-day activities to be carried out by the project participants. Incremental costs of the activities of the Steering Committee are also included

within this Component. The baseline cost, incurred by the national, federal, state, provincial, and local governments, universities, stakeholders and NGOs currently active in the Guarani Aquifer System region, is US \$ 1.91 million. The alternative project cost, adding the transboundary consideration to the current governmental and stakeholder activities, is US \$ 3.50 million. GEF incremental funding is US \$ 1.59 million.

8. Part of the baseline contributing to all project components includes project preparation activities funded through the World Bank, OAS, government counterparts, of US \$ 1.07 million. Associated financing from the IAEA (International Atomic Energy Agency), BGR (German Geological Survey), and World Bank Netherlands Water Partnership Program (BNWPP) in the amount of US \$ 1.26 million is to be made available for this project.

9. It should be noted that specific expenditures for activities may be initiated at any time during the six-month period preceding the indicated date, as human and financial resources, and prerequisite information availability, warrant. Further, it is anticipated that each component within the principle activities is likely to be executed over the period of up to one year, with the SAP formulation occurring over the four-year period of the project.

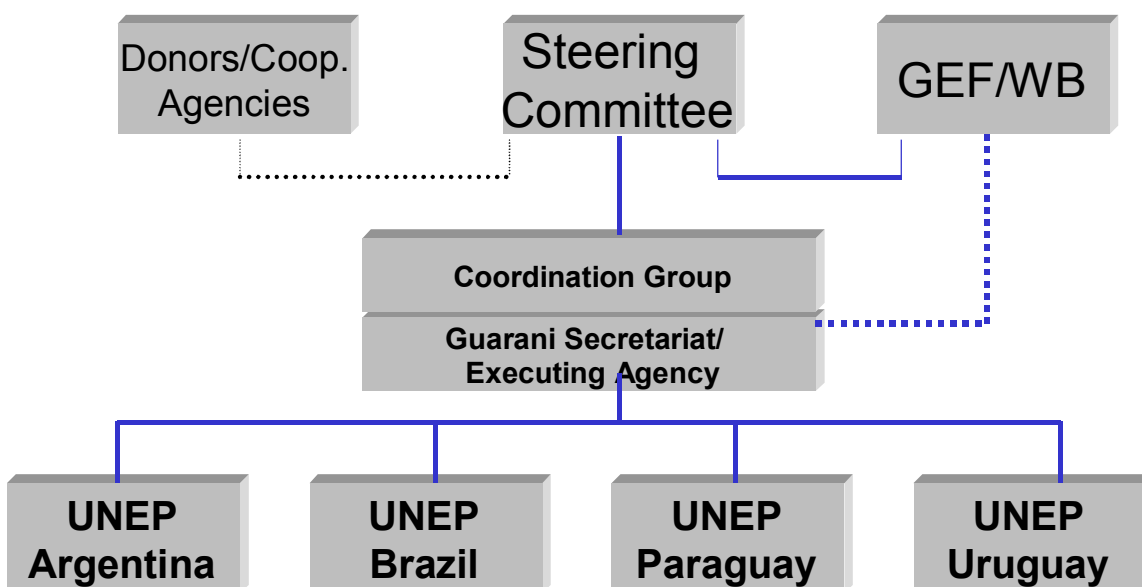
Table 7: Incremental Cost Matrix (US \$M)

Component	Category	Amount	Domestic Benefits	Global Benefits
Expansion and Consolidation of the Knowledge Base	Baseline	5.73	Information on the quality and availability of groundwater resources in the Guarani Aquifer System	
	Alternative	10.51	Same as above, with additional information supporting the sustainable use of the resource and overlying lands	Increased protection and sustainable use of a globally significant groundwater system
	Increment	4.78		
Development and Implementation of a Management Framework	Baseline	3.54	Geohydrometeorological monitoring data	
	Alternative	7.14	Same as above, with added capacity for improved, sustainable groundwater management and decision-making	Positive impacts of coordinated groundwater management, and development of methodologies able to be applied to other international basins
	Increment	3.60		
Public and Stakeholder Participation	Baseline	0.55	Public awareness of water conservation and public health issues	
	Alternative	1.11	Same as above, with public support for appropriate development, utilization and conservation of groundwater	Positive impacts of coordinated groundwater management, and development of programs able to be applied to other international basins
	Increment	0.56		
Project Monitoring and Evaluation	Baseline	0.27	Monitoring and regulation of groundwater quality	
	Alternative	0.75	Same as above, with added capacity to regulate groundwater uses in a coordinated and sustainable manner	Increased protection of groundwater quality and quantity with resultant potential benefit to regional biological diversity and maintenance of surface water resources
	Increment	0.48		

Component	Category	Amount	Domestic Benefits	Global Benefits
Development of Management and Mitigation Measures in Identified Hot Spots	Baseline	1.32	Monitoring and regulation of land use, energy, and economic development	
	Alternative	3.50	Same as above, with added capacity to monitor and regulate the use and potential impacts of land use on groundwater quality and quantity, and promote sustainable economic development	Increased protection of groundwater quality and quantity with resultant potential benefit to sustainable development and human utilization of transboundary underground water resources
	Increment	2.18		
Assessment of Geothermal Energy Potentials	Baseline	0.04	Development of tourism potential, “spas”	
	Alternative	0.25	Same as above, with additional potential for the development of “clean energy” sources	Development of methodologies for the integrated development and sustainable utilization of geothermal energy resources
	Increment	0.21		
Project Coordination and Management	Baseline	1.91	Maintenance of basic monitoring and management functions	
	Alternative*	3.50	Same as above, with improved decision-making capabilities	Development of methodologies for coordination of management and monitoring of multinational groundwater systems
	Increment	1.59		
TOTAL	Baseline (Including Cofinancing*)	13.36		
	Alternative*	26.76		
	Increment	13.40		
PDF Preparation		0.54		
Total Increment		13.94		

* Includes the World Bank-Netherlands Water Partnership (US \$ 0.10 M), the IAEA (US \$ 0.50), and the BGR (US \$ 0.60 M).

ANNEX 5: INSTITUTIONAL ARRANGEMENTS FOR PROJECT IMPLEMENTATION



Steering Committee – Consejo Superior de Direccion del Proyecto

Coordination Group – Coordinación Colegiada

Guarani Secretariat – Secretaria General del Proyecto Sistema Acuífero Guarani

Executing Agency – OAS

UNEP – National Project Executing Unit – Unidad Nacional de Ejecución del Proyecto

GEF/WB – Global Environment Facility – World Bank

Donors/Cooperating Agencies – includes IAEA, BGR, OAS. These and other agencies may be invited to Steering Committee meetings.

ANNEX 6: DESCRIPTION OF THE GUARANI AQUIFER SYSTEM

The Guarani Aquifer System, named in honor of the Guarani Indigenous Nation, is one of the largest groundwater reservoirs in the world. It is located under the four MERCOSUR countries: Argentina, Brazil, Paraguay and Uruguay. Until recently, the Guarani Aquifer System was known as the Botucatu Aquifer in Brazil, the Tacuarembó Aquifer in Uruguay and Argentina, and the Misiones Aquifer in Paraguay.

The Guarani Aquifer System extends from the central-west region of Brazil into Paraguay and the southeastern and southern regions of Brazil, and into northeastern Argentina and central and western Uruguay. (See Annex 13 for area map). The Guarani Aquifer System has an estimated total surface area of approximately 1.2 million square kilometers (839,800 km² in Brazil, 225,500 km² in Argentina, 71,700 km² in Paraguay, and 45,000 km² in Uruguay). The portion within Brazil encompasses about two-thirds of the total areal extent of the System, and included portions of eight Brazilian states—an area equal to that of England, France and Spain combined. An estimated fifteen million people live within the Aquifer's area of surface influence.

About 40,000 km³ of freshwater are contained within the Aquifer. About 90% of this volume is estimated to be potable, although, locally, potability can be reduced due to salinity and elevated fluoride content (affecting less than 10% of the volume). The volume of water in the Guarani Aquifer System is equivalent to the total volume of water conveyed by the Paraná River over a period of almost 20 years (based upon a median flow rate of 10,000 m³/sec). It is estimated that the Aquifer could meet the water demands of 360 million people on a sustainable basis, based on a per capita water use of 300 liters/day—only about 10% of the total freshwater reserves would be depleted after a period of 100 years. Current usage, from deep wells, sustains a per unit rate of abstraction of up to 1 million liters/hour. The Guarani Aquifer System has an average thickness of 250 meters varying from lenses of a few meters at the borders of the groundwater basin to about 600 m in its central parts, such as in the northern parts of the States of São Paulo, Paraná and the southern parts of Mato Grosso do Sul in Brazil. Its depth below the land surface varies from zero in outcropping areas and their vicinity to more than 1,000 meters in Argentina.

Besides the excellent quality of the water (which is very suitable for consumption) another important characteristic of the Guarani Aquifer is the thermal quality of the waters. In a number of regions, the water emerges naturally at temperatures of between 33 and 50 degrees Celsius, at a flow rate of about 100,000 liters/hour. At present, this water is used principally for water supply and tourism, although it could potentially be exploited as an alternative energy source, substituting for non-renewable energy sources in the project area.

Despite large surface water reserves, the drinking water supply in this heavily populated region of the MERCOSUR is increasingly dependent on groundwater. Future problems may occur if groundwater use is not managed in a sustainable manner or if the groundwater becomes polluted. In São Paulo State, Brazil, more than 60% of the water supply needs in urban centers are served totally or partially from groundwater sources, supplying a population of about 5.5 million people. Demands for groundwater are increasing, due to

both demographic growth and economic expansion, and as a consequence of the pollution of surface water sources.

Legal and regulatory mechanisms for the management of groundwater resources are lacking throughout the MERCOSUR region. Both in Argentina and Brazil, for instance, significant pollution of shallow groundwater resources is occurring.

However, also the use of the Guarani Aquifer System's water has increased significantly, in the last decades, as a consequence of the extreme urbanization pattern of some areas on one hand and developments in large scale agriculture schemes on the other. In some areas of the aquifer system there is a high concentration of wells whose water is used for different purposes. The assessments of the preparation phase have resulted in maps showing the spatial distribution of water uses (77% urban drinking purposes, 11,5% industrial use and 11,5% agriculture use), as well as maps with location of wells and their respective depths.

Some of the conflicts related to water quantity are already well identified. These include, among others, the reduction of potentiometric and phreatic levels, and the interference between wells experienced in the highly urbanized areas around Ribeirão Preto and Bauru, in São Paulo State (Brazil) and the transboundary thermal sites between Uruguay and Argentina, particularly in the area of Salto (Uruguay) and Concordia (Argentina).

Preliminary studies carried out during project preparation estimated that water abstractions in the Brazilian states of Minas Gerais, São Paulo and Paraná – if not managed - will surpass the aquifer's local recharge rates by 2025. Some regions in Argentina and Paraguay, where the aquifer's potential has only recently been discovered, are now undergoing groundwater exploitation with an increasing number of wells being drilled. The actual number of wells tapping the aquifer system in those regions is still unknown. It is important to keep in mind that due to the remedial and anticipatory character of the present project, data on the aquifer system are scarce. One of the major activities will be to collect and analyze data for the Guarani Aquifer System.

As in the MERCOSUR region in general, in most areas of the aquifer system, the countries' legal frameworks for managing and monitoring groundwater use have not accompanied the rates of extraction and expansion of groundwater use. The lack of control over the quality design of the wells seems to have caused wells to have acted in some cases as drainage channels for surface contamination.

In regions of the aquifer system where water quality monitoring data are being collected systematically (like in CETESB's well-functioning monitoring network in São Paulo State), some cases of organic contamination (high nitrate content) and anomalous pesticide traces have been detected. This is also assumed to be occurring in other regions of the aquifer, particularly in recharge areas showing high natural vulnerability, and in semi-confined areas which show an effective connection with underlying unconfined and contaminated aquifers.

The Hot Spot area of Santana do Livramento – Rivera, at the Brazil/Uruguay border, is a case in point, with one of the largest urban concentrations in the southern aquifer system's outcropping area (around 200.000 inhabitants), and with a water supply system that relies almost entirely on groundwater extracted from about 160 tube wells with depths between 40 m and 160 m. Here, the aquifer faces the threats of lacking sanitation infrastructure (60% of the population served by inadequate sanitation schemes– *fossas negras e sumidouros*), industrial plants, and an increased use of pesticides and fertilizers in agriculture.

A similar situation applies to the Eastern Paraguay region, a vulnerable non-confined area that is experiencing booming urban and agricultural expansion. Particularly in this region the stratigraphy of the aquifer formations is not very well defined, which makes the task even more challenging.

In Ribeirão Preto, Brazil, a city with 421,000 inhabitants mainly using Guarani waters, 12% of water users do not have access to the sewage system, generating a potential nitrate load of 200,000 tons per year, which is considered rather elevated. A comprehensive and detailed survey about the groundwater's chemistry, considering regional potential contaminants is one of the main tasks of Component 1 of the project. It will be a guide for further activities such as the set up of a water quality monitoring network and advanced hydro chemical research.

ANNEX 7: ROOT CAUSE ANALYSIS

1. Background. The Guarani Aquifer System is one of the largest groundwater reservoirs in the world. It is located under the four MERCOSUR countries: Argentina, Brazil, Paraguay and Uruguay. The Guarani Aquifer System extends from the central-west region of Brazil into Paraguay and the southeastern and southern regions of Brazil, and into northeastern Argentina and central and western Uruguay. The Guarani Aquifer System has an estimated total surface area of approximately 1.2 million square kilometers (839,800 km² in Brazil, 225,500 km² in Argentina, 71,700 km² in Paraguay, and 45,000 km² in Uruguay). The portion within Brazil encompasses about two-thirds of the total areal extent of the System, and included portions of eight Brazilian states—an area equal to that of England, France and Spain combined. An estimated fifteen million people live within the Aquifer's area of surface influence. See Annex 13 for area maps).

2. Issues. Legal and regulatory mechanisms for the management of groundwater resources are lacking throughout the MERCOSUR region. Both in Argentina and Brazil, for instance, significant pollution of shallow groundwater resources is occurring, although, due to its significant average depth, the Guarani Aquifer System is not significantly affected by this type of degradation. However, in areas where the Guarani Aquifer System is close to the land surface, there are pollution threats posed by the use of the Guarani Aquifer System waters in irrigation schemes and potential leaking of agrochemicals in highly mechanized intensive agriculture areas. In addition, it is being potentially overdrafted with consequent negative impacts on its quality.

The Guarani Aquifer System is a strategic water resource within the MERCOSUR region. It can be preserved if adequately protected and managed. The main threat to the resource stems from uncontrolled pollution in extraction and recharge areas. Given that groundwater pollution is reversible only at very high costs, if at all, there is considerable merit in protecting the Guarani Aquifer System for current and future generations.

3. Problems and Symptoms. The Guarani Aquifer System is a clear example of an international (*transfronterizo*) waterbody threatened by environmental degradation through pollution, as defined and included in the GEF Operational Program Number 8. In the absence of a strategic intervention supported by the GEF, the likelihood of “business-as-usual” prevailing in the four countries is high. At the aquifer's current rate of use, and considering the growing use of groundwater for human consumption, it is easy to foresee an increasing threat of pollution in the not too distant future. The uncontrolled use of the Guarani Aquifer System, without rules or regulation, can alter its status from that of a strategic reserve of drinking water for the population in portions of Argentina, Brazil, Paraguay and Uruguay, to that of a degraded waterbody that is the source of conflict among the countries. If nothing is done, the future of this underground treasure could be the same as that of other aquifers that have tended to become both polluted and over-exploited, at least in certain areas. The global benefit of the proposed project is in terms of the preservation of this transboundary resource for current and future generations. In the

specific case of the Guarani Aquifer System, there is the opportunity to exploit the advantages of preventive activity. The project would ensure that, in the face of increasing scarcity and pollution of surface water sources in the beneficiary countries, this resource will be managed today so as to be available as a strategic reserve when needed in the future. An important issue to be considered in this regard is the fact that an international legal framework for the management of transboundary groundwater resources currently does not exist.

To this end, it should be noted that the World Bank, for example, does not have a specific policy on groundwater resources. This issue is being addressed in the ongoing evaluation of the World Bank Water Resources Policy Paper of 1993. It is generally recognized that transboundary groundwater issues need to be addressed, as projects are often proposed and implemented in areas where a situation of scarcity and competition for groundwater resources already exists (e.g., in North Africa and the Middle East). In the case of the Guarani Aquifer System of South America, the World Bank, through the GEF, could make a significant contribution to shaping an institutional framework regarding transboundary groundwaters that could serve as a replicable model in other countries and regions. In addition, the experience derived from this project would be expected to contribute to GEF and World Bank policy with regard to transboundary groundwater issues.

3.1 Problems related to poorly quantified environmental impacts. As noted above, the actual configuration and extent of the Guarani Aquifer System remains largely unknown. Notwithstanding, problems related to the contamination of portions of the groundwater reservoir are known to exist, particularly in those areas where the aquifer is at or near the land surface. In addition, in those areas where the aquifer is being heavily utilized for water supply purposes, localized problems with overdrafting of the water resource are presumed to exist, with concomitant potential impacts on economic activities and surface ecosystems that are intimately linked with the groundwater system.

3.2 Problems related to stakeholder involvement. Problems related to stakeholder involvement historically have been related to the utilization of groundwater as an alternative water source for human economic activities, especially in areas where surface water resources are lacking or contaminated from human activities. As noted above, the Guarani Aquifer System is viewed by the countries as a reserve of potable freshwater to be utilized primarily for the future economic development of the basin countries. Notwithstanding, concerns have been identified within the basin with respect to the utilization of the waters of the Guarani Aquifer System to support tourism, particularly in the vicinity of western Uruguay and northeastern Argentina. Such concerns impact the sustainable utilization of the resources, and indicate a need to sensitize stakeholders with respect to the nature, attributes, behavior, and hydrology of the Guarani Aquifer System.

3.3 Problems related to economic development. Problems related to economic development include the lack of appropriate regulations governing the exploitation of groundwater resources for human purposes. Because of the strategic nature of the Guarani Aquifer System within the context of the MERCOSUR region, the need to develop an appropriate framework within which to support sustainable economic activities, including both current uses and potential future uses of the Guarani Aquifer System, forms an

important issue to be addressed by this project. Such concerns are best addressed in a sectoral context, with the participation of key stakeholders.

3.4 Problems related to institutions, human resources, and the lack of a holistic management approach. Problems related to institutions and human resources include the lack of a comprehensive framework of data acquisition and data-sharing within the Guarani Aquifer System region. This lack contributes to difficulties in developing and implementing an appropriate legal and regulatory framework within which to manage the resources of the Guarani Aquifer System. Related to the lack of institutional capacity are emerging problems related to the lack of authority to control environmental problems, and fragmented and locally focused jurisdictions that have failed to bring a comprehensive and cohesive approach to water management in the Guarani Aquifer System region. Further, some management and development-related actions are fragmented among agencies and between local jurisdictions. As a consequence, potential problems relate to the lack of a unified vision of the Guarani Aquifer System as an integrated whole are likely to occur in the absence of further interventions in the region. Potential problems include inter-sectoral conflicts over water usage, competing rather than complementary demands for water, and a piecemeal approach to water resources development in the basin.

3.5 Problems of water quality. Problems related to water quality include localized bacteriological contamination and contamination by synthetic organic (agro-) chemicals. These problems are currently localized to specific areas of the Guarani Aquifer System region, especially with respect to those wells that lack effective casings.

3.6 Problems of water quantity. Problems related to water quantity are highly localized within the Guarani Aquifer System, and are related to localized overdrafting of the resource.

4. Root Causes. Despite the apparent proliferation of problems in the Guarani Aquifer System region, there would appear to be relatively few root causes that contribute to the majority of the potential problems likely to be observed or to occur in the future in the absence of further interventions to protect the resource. The root causes of existing and potential problems will be identified during this project.

4.1 Anthropogenic causes. People almost exclusively have the potential to degrade the Guarani Aquifer System. Although increased economic development in the region has succeeded in improving the quality of life for many of the citizens of the region (as intended), rates of exploitation of the natural resource base have increased. In the first instance, the redistribution of population in the region has led to increased urbanization, which in turn has the potential to contribute untreated human wastes and other contaminants to the system. These populations have also created an increased demand for water and food, both of which affect the potential for overdrafting the Aquifer—the water being used primarily for potable purposes. Superimposed on these causative factors are modifications of the natural hydrological regime caused by the imposition of impervious surfaces on recharge areas, and modifications affecting natural discharge areas of the Guarani Aquifer System. In addition, emerging demands for “clean” energy for use by the people and industries of the basin constitute an emerging challenge related to the extraction

and disposal of thermal waters. Currently, many of the potential impacts are highly localized, and there is an opportunity to put into place mechanisms to mitigate and manage many of these threats.

4.2 Legal and institutional causes. While human land use activities have the potential to contribute significantly to the potential degradation of the Guarani Aquifer System, legal and institutional shortcomings may exacerbate these problems by failing to control or regulate human actions in the area. Existing mechanisms fail to view the Aquifer as a unit, in which actions taken at specific sites have a cumulative effect throughout the system. While the consequences of such fragmented institutional mechanisms are currently quite minor, should the situation not be remedied, substantial and costly actions may be needed in the future to overcome this lack of regulation, and lack of a holistic approach to ecosystem and economic development.

5. Actions Identified to Address Root Causes. To help in overcoming the historical inertia inherent in the causative factors identified above, emphasis in project design has been given to those actions which address root causes that can best be humanly managed; i.e., those anthropogenic causes and legal and institutional causes that can be modified through planning and subsequent implementation of corrective actions. Natural root causes generally cannot be effectively controlled by human actions and hence are of lesser importance from a groundwater management perspective (although knowledge of these causes is an essential starting point from which to implement interventions to address human and institutional causes). The following actions have been proposed to address the human causative factors of potential environmental degradation of the Guarani Aquifer System.

5.1 Acquisition of basic scientific information and dissemination of knowledge. Project activities have been developed to acquire and disseminate supplementary baseline information to support determination of root causes (Components I and II), and investigate alternative courses of action to ensure sustainable use practices (Component V). In addition, a further group of activities has been proposed as a means of synthesizing and disseminating information gathered through diagnostic studies. These include, *inter alia*, activities which demonstrate ways in which citizens can contribute to the protection of community water resources, which address the need for public informational programming to enhance citizen participation in the decision-making process, and which train community-based extension agents to disseminate information on issues and mitigation measures to citizens (Component III).

5.2 Development of a holistic institutional management framework. Project activities have been developed to provide an integrated management framework within which groundwater protection and management activities can be identified and carried out (Component II). Project activities in this category include, *inter alia*, activities which address the needs to harmonize technical approaches for data acquisition and share information within the Guarani Aquifer System region. These activities also encompass the synthesis and integration of the strategic elements of the foregoing project activities in the SAP, or Strategic Action Program.

5.3 Support to groundwater management and regulatory agencies. Project activities have been developed to provide directed support to create and strengthen the operational capabilities of institutions, committees, and related civic organizations within the Guarani Aquifer System region. These activities include, *inter alia*, activities which promote the establishment of a framework to promote stakeholder involvement and participation (Component III), and refine and strengthen the role of the existing agencies within the basin through twinning and other capacity building activities (Component II).

5.4 Assessment of emerging concerns. Finally, project activities have been developed to provide a thorough consideration of the use of the Aquifer for geothermal energy production, an emerging issue that is related to human use of the Guarani Aquifer System and its water reserves (Component VI). These activities will inform decisions relating to the potential future development and use of the Guarani Aquifer System for human purposes, including their economic, technical, and environmental dimensions.

6. Concluding remarks. Significant progress has been made in the definition of issues and problems (and their root causes in some instances) within the Guarani Aquifer System region during the project preparation phase. Work proposed under the GEF International Waters focal area builds on this progress in seeking to extend region-wide actions to the local community. This work is predicated upon the principles of civic involvement, public participation, and responsible governmental action at all levels of government, and embodies a comprehensive program of research, demonstration projects, and information dissemination designed to identify a framework for subsequent preventive and remedial measures and management actions that will result in the sustainable economic development of this region.

ANNEX 8: STRATEGIC ACTION PROGRAM

1. The GEF Process. The GEF International Waters (IW) Projects often follow a logical sequence of diagnosis and analysis, culminating in the preparation of an agreed program of strategic actions to address common transboundary issues of concern. To this end, GEF IW projects often begin with the GEF Implementing Agencies assisting the cooperating countries in undertaking strategic work that focuses on joint fact-finding. Consistent with the Operation Strategy (OP), the joint fact-finding encourages collaborating countries to institute interministerial technical teams to assemble information on water-related problems and conflicts in the basin, and to share this information with counterparts from other countries within the multinational basin. Such information forms the basis for defining and quantifying shared, transboundary concerns. Such concerns are documented in a Transboundary Diagnostic Analysis (TDA) that contains the facts of the actual or likely future issues of concern, conflicts, and problems. These facts and the associated diagnostic analysis facilitate identification of the root causes of the concerns, conflicts, and problems, and enables actions to resolve shared issues of concern. A key element in developing actions to resolve water-related conflicts, disputes, and problems is the involvement of stakeholders; the principal actors involved in water use and management having been identified as an element of the TDA. This collaborative, factual analysis is essential to the process of determining priorities for action, and is the first step in formulating a Strategic Program of Actions (SAP) designed to address the root causes of the concerns in an effective and collaborative manner. The TDA-SAP process has been adopted by the GEF Council as the basis for GEF IW projects.

2. Transboundary Diagnostic Analysis. The process of developing the TDA enables countries to learn how to exchange information and work together. Interministerial committees often are established in each country to assemble and provide factual information on the country-portion of shared waterbodies. By reviewing and analyzing the data and information provided by each country, the transboundary nature, magnitude, and significance of water quality, biological, habitat or other land use-related conflicts, degradation or threats can be determined and prioritized. This review and analysis provides an objective basis for the countries to jointly assign relative degrees of concern to the issues identified, and separate those issues that are of joint concern from those that are of national concern. In addition, the root causes of the conflicts or degradation, and relevant social issues, can be identified. This analysis will also enable the identification of key stakeholders and communities. While social and societal concerns are identified and quantified to the extent possible, the TDA is intended to be a technical document, prepared by the scientific community within the countries participating in the GEF IW project.

3. The TDA process provides the opportunity for the countries to identify and understand the linkages between problems and their root causes. By categorizing these causes within specific economic sectors, this analysis permits the active participation and engagement of key stakeholders. This enables the preparation of holistic, comprehensive, cost-effective solutions for complex transboundary problems. It also enables these problems to be defined in terms of manageable elements, linked to specific and identifiable

geographic localities, or “hot spots”, that can be readily prioritized in terms of an agreed system of prioritization developed by the collaborating countries.

4. Strategic Action Program. The resulting actions required to address priority transboundary issues of concern, identified through the TDA process, are further developed and articulated within the Strategic Action Program. This program sets out a series of agreed actions needed to minimize or mitigate identified water quality, biological, habitat or other land use-related conflicts, degradation or threats within specific economic sectors and in specific geographic locations. These actions generally include specific policy, legal, and institutional actions, reforms and investments on a multicountry and national basis. These specific actions generally are developed at the country level, often through the interministerial committees with the active participation of stakeholders at the national and subnational levels, that are subsequently compiled and agreed at the multicountry level. In most cases, the development of multicountry strategic action programs complement specific action plans developed by the collaborating countries. These latter plans, individual national action plans (NAPs), form the national commitment of the countries to the implementation of strategic actions necessary to bring about the sustainable development and utilization of shared, transboundary resources. Such country-level actions, in turn, may be eligible for additional GEF assistance in the implementation of those additional, or incremental, actions necessary to give effect to the agreed transboundary benefits identified in the SAP. These incremental costs reflect the various states of economic development within the collaborating countries, and serve as the basis for GEF IW implementation projects.

5. Enabling Activity. In essence, this multicountry process of issue identification, quantification, prioritization, and action planning constitute the equivalent of the “enabling activities” identified within the other GEF focal areas. Enabling activities are those fundamental steps that must be taken in order for collaborating countries to address priority concerns established by the conventions. To this end, the SAP forms an important and essential step in identifying country-driven commitments to action that may reduce the risk of failure of subsequent GEF interventions that assist in the implementation of country-driven actions.

6. Monitoring and Evaluation. A final step in the GEF process is that of monitoring of project implementation, which allows project management to take appropriate corrective actions during the course of the conduct of project activities, and evaluation, which measures project performance, efficiency, and impact against pre-determined milestones or indicators. Evaluation indicators are generally set forth in the Logical Framework as a part of project design.

7. Guarani Aquifer System Project. As noted previously, the primary outcome of the project will be an agreed Strategic Action Program, consistent with the GEF process outlined above. This program will be based upon a sound technical and scientific process of data acquisition, sharing, and analysis, setting forth issues of transboundary concern. To this end, an operational system of data acquisition and data-sharing is an integral part of the Guarani Project—contained within Components I and II of the proposed GEF IW project. Because of the close linkage between the technical analysis (TDA) and the

resultant priority, strategic actions necessary to address the root causes of agreed multicountry concerns, the identification of regionally-appropriate, cost-effective mitigation and management measures (Component V), acceptable to basin communities and key stakeholders (see Component III), also form critical elements of the Guarani Aquifer System project. In order to ensure the sustainability of these management and mitigation measures, and data acquisition and sharing mechanisms, the Guarani Project also includes institutional strengthening and capacity building (Component IV) as important activities within the project framework. Finally, the proposed project activities also recognize emerging issues related to the Guarani Aquifer System, and specific investigations with respect to the potential development of the Aquifer for geothermal energy, are also included within the framework of the project (Component VI). All of these activities contribute to the development of a sustainable multicountry framework for the sustainable management and development of the Guarani Aquifer System.

ANNEX 9. AVAILABLE REFERENCE DOCUMENTS

1. This annex presents a list of the publications on the Guarani Aquifer System that were prepared as a result of the project formulation (PDF/B) activities. These documents form the documented basis for the formulation of the Transboundary Diagnostic Analysis (TDA) and Strategic Action Plan (SAP) for the Guarani Aquifer System proposed as the outcome of this project.

2. Work Products by Work Program Element.

1.1 COMPONENT I. Expansion and Consolidation of the Current Knowledge Base on the Guarani Aquifer System

Activity 1. Survey of all existing technical data

- FUNPAR, Informe Final de la Consultoría: *Expansión y consolidación de la base actual de conocimiento básico; Estudios Básicos del Acuífero*, February 2001.

Activity 3. Study of the actual and potential uses of the aquifer

- Jorge de los Santos and Chang Kiang, Informe Final de la Consultoría: *Estudio del uso actual y potencial del Acuífero Guaraní*, March 2001.

1.2 COMPONENT II. Joint Development and Implementation of the Guarani Aquifer System Management Framework

Activity 2. Definition of relevant information for aquifer monitoring network

- Albert Mente, Informe Final de la Consultoría: *Definición de información relevante para la red de monitoreo del acuífero*, January 2001.

Activity 4. Technical and conceptual design of the information system

- Noemi Tardivo, Informe Final de la Consultoría: *Sistema integral de información geográfica para la gestión del agua del Sistema Acuífero Guaraní*, March 2001.

Activity 5. Survey of existing legal-institutional framework

- Corina Fernández, Informe Final de la Consultoría: *Levantamiento y análisis del Marco jurídico-institucional y aspectos legales en la materia hídrica ambiental de Argentina*, March 2001.
- Cid Tomanik Pompeu, Informe Final de la Consultoría: *Levantamiento y análisis del Marco jurídico-institucional y aspectos legales en la materia hídrica ambiental de Brasil*, March 2001.

- Lauro Ramírez, Informe Final de la Consultoría: *Levantamiento y análisis del Marco jurídico-institucional y aspectos legales en la materia hídrica ambiental de Paraguay*, April 2001.
- Arturo Navarro, Informe Final de la Consultoría: *Levantamiento y análisis del Marco jurídico-institucional y aspectos legales en la materia hídrica ambiental de Uruguay*, February 2001.

Activity 6. Preparation of TOR for a Strategic Action Plan

- Jorge Rucks, Stephen Foster, Roberto Ronchietto, Luiz Noronha, Eduardo Mestre, Roberto Kirchheim, Griselda Castagnino, Informe Final del PEA : *Programa Estratégico de Acción: Resumen Ejecutivo, Descripción y Términos de Referencia*, March 2001.

Activity 11. Institutional assessment of involved agencies

- Luiz Noronha, Informe Final de la Consultoría: *Propuesta de Desarrollo Institucional y de Arreglos Institucionales*, April 2001.

L3 COMPONENT III. Public Participation

Activity 7. Identification of stakeholders, education and communication needs, and pilot projects for public participation

- María Elena González Pioli, Informe Final de la Consultoría: *Necesidades de educación ambiental y del agua, comunicación social y proyectos piloto para la participación e involucramiento público*, March 2001.

Activity 8. . Definition of mechanisms for communication and public participation in decision making

- Mario Bernalt, Informe Final de la Consultoría : *Identificación de actores, definición de mecanismos para comunicación y participación pública que se requerirán durante el proceso de ejecución del proyecto*, March 2001.
- Proceedings of the Seminar on the Guarani Aquifer, Foz do Iguaçu; January 31 – February 1, 2000.
- Reports of the Public Participation Workshops:
 - a. July 12-14, 2000 - Santa Fe, Lanzamiento del Proyecto, implementación de arreglos institucionales y definición de marco Lógico y aspectos técnico-científicos del Programa del PSAG
 - b. November 28-29, 2000 - Asunción, Revisión de Avances del Proyecto y Reorientaciones de Aspectos Técnicos, Científicos y Legales - Institucionales para apoyar la Preparación del Proyecto;
 - c. March 14-17, 2001 - Montevideo, Propuesta de PEA, incluyendo TORs; definición de Bases de las Componentes 1 y 5 del Documento de Proyecto
 - d. April 3-4, 2001 - Montevideo, Académicos, Revisión de Componentes 1, 5 y 6 de la Descripción del Proyecto

- e. April 23-24, 2001 - Montevideo; Revisión de la Estructura y contenidos de la Descripción del Proyecto;
- f. May 7-8, 2001 - Asunción; Revisión y contrapropuesta de Arreglos Institucionales; Revisión de las bases de Costos del Proyecto;
- g. May 28-30, 2001 - Salto; Revisión y Consenso de la Documentación resultante de la Fase de Preparación del Proyecto; para la Protección Ambiental y Desarrollo Sostenible del Sistema Acuífero Guaraní

I.4 COMPONENT IV. Project Monitoring and Evaluation, and Dissemination of Project Results

Activity 10. Elaboration of project evaluation plan

- Álvaro Soler. Informe Final de la Consultoría : *Sistema de Seguimiento, Evaluación y Retroalimentación del Proyecto y diseminación de sus resultados / productos*, June 2001.

I.5 COMPONENT V. Development of Management and Mitigation Measures within Identified “Hot Spots”

Activity 9. Identification of possible pilot areas for implementation of programs and development of TORs for pilot programs

- Alberto Calcagno, Informe Final de la Consultoría : *identificación de áreas para la ejecución de programas y acciones piloto y definición de términos de referencia*, March 2001.

I.6 COMPONENT VI. Development of Geothermal Energy Potentials

- Hydrothermalism. Lars Tallbacka, Informe Final de la Consultoría : *Geothermal Project Component*, June 2001.

I.7 COMPONENT VII. Project Coordination and Management

Activity 12. Technical Editing SAP

- Jeffrey A. Thornton, Informe Final de la Consultoría : *Formulación Final del PAD (Project Appraisal Document)*, June 2001.

Activity 13. Incremental cost analysis

- Roberto Ronchietto, Informe Final de la Consultoría : *Análisis de Costos Incrementales del Proyecto*. June 2001.

Activity 14. Project Coordination and Technical-Administrative Support

- Eduardo Mestre, General Secretary: *Monthly Progress Reports on the Guaraní Aquifer System Project, Preparation Phase*; July, 2000 – June, 2001; *SG Final Appraisal Report*, June, 2001
- Roberto Kirchheim and Griselda Castagnino, Informes Finales de la Consultoría : *Apoyo técnico, científico y administrativo a la Operación del Secretaría General del PSAG*, June 2001.

1.8 Complementary Activities

- Indigenous Groups. Esther Prieto, Informe Final de la Consultoría : *Preparación de las Bases para la Participación e Involucramiento de las Comunidades Indígenas en las actividades de Gestión Sostenible e Integrada, y Protección Ambiental del Sistema Acuífero Guaraní*, June 2001.

ANNEX 10: PUBLIC INVOLVEMENT PLAN SUMMARY

1. The formulation of the proposal for the Environmental Protection and Sustainable Development of the Integrated Management of the Guarani Aquifer System, including its proposed GEF components, has involved extensive and broad-based participation by representatives of the municipal/departamental, state/provincial, and national/federal governments, academic and research institutions, private sector representatives and nongovernmental organizations. The participation process was facilitated by a series of consultative workshops, conducted in Foz do Iguaçu (Brazil) during January 2000, Santa Fe (Argentina) during July 2000, Asunción (Paraguay) during November 2000, Montevideo (Uruguay) during March and April 2001, Asunción during May 2001, and Salto (Uruguay) during May 2001. In addition, a number of focus group sessions were held to solicit sectoral input from NGOs, in Garopaba and Caxambú (Brazil) during November 2000, and in Rio Grande do Sul (Brazil) during May 2001; from the private sector, in Brasília (Brazil) during March 2001 and Florianópolis during May 2001; and, from the indigenous peoples groups in Brazil during May 2001 and in Paraguay during June 2001.

2. Approximately 200 persons representing more than 100 institutions, government agencies, and NGOs, participated in the public meetings and provided inputs in drafting this proposal, many of which are expected to participate in the implementation of the project.

3. A list of those institutions that participated in the public meetings convened prior to the preparation of this project document, and which are expected to participate in project implementation as well as subsequent public meetings, is presented below. Governmental organizations are categorized as national/federal or as provincial/state government agencies. Nongovernmental organizations and other governmental bodies are also listed, including state- (Brazil) and provincial- (Argentina) level governmental agencies. Where the participating organizations are known by an acronym, the acronym is also shown.

4. NATIONAL AND FEDERAL GOVERNMENTAL ORGANIZATIONS

Argentina

- Ministerio de Relaciones Exteriores y Culto
- Subsecretaría de Recursos Hídricos -Sistema Nacional de Información - SNIH/SRH
- Secretaría de Desarrollo Sustentable y Política Ambiental- SDSPA
- Instituto Nacional del Agua y del Ambiente - INA

Brazil

- Ministério de Relações Exteriores - MRE
- Ministério do Meio Ambiente – MMA
Secretaria de Recursos Hídricos – SRH
Secretaria de Qualidade Ambiental –SQA
Secretaria Executiva - SECEX
Mercosul – SGT-6
- Ministério de Minas e Energia - MM

Departamento Nacional da Produção Mineral –DNPM
Companhia de Pesquisa de Recursos Minerais – CPRM
Secretaria de Energia

- Agência Nacional da Água – ANA
- Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renováveis – IBAMA
- Ministério da Saúde MS
- Fundação Nacional da Saúde – FUNASA
- Agência Nacional de Vigilância Sanitária - ANVISA
- Ministério da Integração Nacional -MI
- Ministério do Planejamento, Orçamento e Gestão
Secretaria de Assuntos Internacionais- SEAIN
- Ministério da Agricultura – MA
- Empresa Brasileira de Pesquisas Agropecuárias – EMBRAPA
- Fundação Nacional do Índio – FUNAI
- Ministério da Ciência e Tecnologia - MCT
- Ministério da Defesa - MR
- GSI / Presidência da República

Paraguay

- Secretaría Medio Ambiente - SEAM
- Secretaría Técnica de Planificación - STP
- Ministerio de Salud Pública y Bienestar Social- SENASA - Servicio Nacional de Saneamiento Ambiental
- Ministerio de Obras Públicas y Comunicaciones (M.O.P.C.) – Viceministerio de Minas y Energía
- Ministerio de Relaciones Exteriores
- Cooperativa Nacional de Aguas y Saneamiento - CORPOSANA
- Secretaría del Ambiente - Proyecto Saro - Sistema Ambiental de la Región Oriental
- Programa Regional. Piloto Uft
- Servicio Geológico Geotécnico
- Ente Binacional Yaciretá-Itaipu

Uruguay

- Ministerio de Relaciones Exteriores
- Ministerio de Transporte y Obras Públicas - Dirección Nacional de Hidrografía – MTOP -DNH
- Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente - Dirección Nacional de Medio Ambiente – MVOTMA-DINAMA
- Ministerio de Ganadería Agricultura y Pesca – Programa Prenader
- Ministerio de Industria, Energía y Minería - Dirección Nacional de Minería y Geología -DINAMIGE
- Obras Sanitarias del Estado – OSE

5. PROVINCIAL AND STATE GOVERNMENTAL ORGANIZATIONS

Argentina

- Dirección Provincial de Obras Hidráulicas de Santa Fé - SPAR
- Dirección de Hidráulica Provincia de Entre Ríos - Ministerio de Obras Públicas
- MOSRV
- Administración Provincial del Agua - APA - Provincia del Chaco
- Instituto Misionero de Agua y Saneamiento - IMAS - Provincia de Misiones

Brazil

- Agência Goiana de Meio Ambiente e Recursos Naturais
- Fundação Ecológica de Mineiros - FEMAS
- Fundação Estadual do Meio Ambiente de Mato Grosso – FEMA
- Companhia de Saneamento do Estado do Mato Grosso – SANEMAT
- Companhia Matogrossense de Mineração– METAMAT
- Secretaria de Estado de Meio Ambiente e Desenvolvimento Sustentável do Mato Grosso do Sul - SEMA
- Secretaria de Estado de Planejamento e de Ciência e Tecnologia do Mato Grosso do Sul– SEPLANCT
- Companhia de Saneamento do Estado do Mato Grosso do Sul – SANESUL
- Fórum Permanente de Meio Ambiente e Desenvolvimento Sustentável do Mato Grosso do Sul – FORMADS
- Conselho de Desenvolvimento e Integração – COSESUL/MS
- Instituto Mineiro de Gestão de Águas – IGAM
- Centro de Desenvolvimento de Tecnologia Nuclear – CDTN
- Companhia de Saneamento do Estado de Minas Gerais – COPASA
- Fundação Centro Tecnológico de Minas Gerais – CETEC
- Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustentável– SEMAD
- Secretaria de Planejamento e Coordenação Geral do Estado do Paraná – SEPL/CCPG
- Secretaria de Estado de Meio-Ambiente e Recursos Hídricos do Estado do Paraná
- Superintendência de Desenvolvimento de Recursos Hídricos e Saneamento Ambiental - SUDERHSA/PR
- Secretaria Estadual de Meio Ambiente do Estado do Rio Grande do Sul- DRH/SEMA
- Companhia de Saneamento do Rio Grande do Sul – CORSAN
- Secretaria de Obras Públicas e Saneamento do Rio Grande do Sul – SOPS
- Secretaria de Coordenação e Planejamento Estado do Rio Grande do Sul
- Secretaria de Desenvolvimento Urbano e Meio Ambiente do Estado de Santa Catarina - SDM
- Secretaria de Estado do Desenvolvimento Econômico e Integração Ao Mercosul do Estado de Santa Catarina – SDE
- Departamento de Águas e Energia Elétrica -Secretaria de Recursos Hídricos Saneamento e Obras do Estado de Sao Paulo – DAEE SRHSO
- Secretaria do Meio Ambiente do Estado de Sao Paulo - SMA
- Instituto Geológico – IG/SMA
- Secretaria do Meio Ambiente do Estado de Sao Paulo - Instituto Florestal – IF/SMA

- Companhia de Saneamento Básico do Estado de São Paulo - SABESP
- Companhia Tecnologia e Saneamento Ambiental – CETESB
- Departamento de Água e Energia Elétrica – DAAE – Marília -SP
- Instituto de Pesquisa Tecnológica – IPT
- Instituto Geográfico e Cartográfico - IGC

6. LOCAL GOVERNMENTAL ORGANIZATIONS

Paraguay -- Gobiernos de los Departamentos Alto Paraná-Itapúa-Caaguazú-Concepción

Uruguay -- Intendencias de los Departamentos de Salto y Paysandú

7. UNIVERSITIES

Argentina

- Universidad de Buenos Aires - UBA
- Universidad Nacional del Litoral - UNL/FICH
- Universidad del Centro - Instituto de Hidrología de Llanuras - UNICEN/IHL
- Universidad de la Plata - CISABA
- Universidad Católica de Santa Fe

Brazil

- Universidade Federal de Minas Gerais - UFMG
- Universidade Federal de Mato Grosso -UFMT
- Universidade Federal de Mato Grosso do Sul -UFMS
- Universidade Federal do Paraná –UFPR
- Universidade Federal do Rio Grande do Sul -UFRGS
- Universidade Federal de Santa Catarina – UFSC
- Universidade Federal de Goiás - UFG
- Universidade de São Paulo - USP
- Universidade Federal de Uberlândia – UFU
- Universidade Federal de Santa Maria - UFSM
- Universidade Estadual Paulista "Júlio de Mesquita Filho" - UNESP
- Universidade do Vale dos Sinos - UNISINOS
- Universidade Estadual de Mato Grosso do Sul - UEMS
- Universidade Católica Dom Bosco - UCDB
- Universidade para o Desenvolvimento Regional do Pantanal - UNIDERP
- Universidade de Caxias do Sul - UCS
- Universidade de Campinas - UNICAMP

Paraguay

- Universidad Nacional de Asunción

Uruguay

- Universidad de la República

8. NONGOVERNMENTAL ORGANIZATIONS (NGOs)

Argentina

- Asociación Latinoamericana de Hidrología Subterránea
- Instituto de Estudios e Investigaciones para el Medio Ambiente
- Comisión Desarrollo Sustentable Cuenca del Plata
- Fundación Ambiente e Recursos Naturales

Brazil

- Fórum Meio Ambiente
- Consórcio Intermunicipal para o Desenvolvimento Integrado das Bacias Dos Rios Mirandas e Apa – CIDEMA
- Associação Brasileira de Águas Subterrâneas – ABAS/MG
- Associação Brasileira de Engenharia Sanitária – Regional de Minas Gerais - ABES/MG
- Associação Brasileira de Recursos Hídricos – Regional de Minas Gerais - ABRH/MG
- Comitê de Bacia Hidrográfica do Rio Araguari
- Comitê de Bacia Hidrográfica do Rio Taquari-Antas
- Associação Brasileira de Águas Subterrâneas – ABAS/PR
- Associação Brasileira de Águas Subterrâneas – ABAS/RS
- Conselho Regional de Engenharia e Agronomia - CREA/RS
- Fórum – Comitês de Bacias
- Instituto Biguá
- ONG Grito das Águas
- Ecologia e Ação
- Instituto Guacuí Sos Rio das Velhas
- Sociedade de Defesa Regional do Meio Ambiente
- Grupo Ambientalista Ibty Caray
- Fundação Emas
- Coalisão Rios Vivos

Paraguay

- Ceamso
- Alter Vida
- Asociación de Geólogos del Paraguay
- Sociedad Paraguaya de Agua Subterránea
- Sobrevivencia – Apoyo Integral a Comunidades Nativas y Ecosistemas

Uruguay

- Asociación Soriano para la Defensa de los Recursos Naturales
- Centro Interdisciplinar de Estudio Sobre el Desarrollo
- Grupo Ñangapire
- Instituto de Ecología del Río Uruguay
- Comisión Técnica Mixta de Salto Grande

9. PRIVATE SECTOR ORGANIZATIONS

Paraguay

- Grupo Minero Guaraní
- Hidrógeno
- Sociedad de Estudios de la Tierra (SETI)

ANNEX 11: LETTERS OF ENDORSEMENT

The Letters of Endorsement by the four countries' GEF Focal Points will be included in the final document to be submitted to the GEF Council.

ANNEX 12: GEF STAP REVIEW AND IA RESPONSE

TECHNICAL REVIEW

" Project for the Environmental Protection and Sustainable Development of the Guarani Aquifer System"

Review carried out by:

Edwin D. Ongley PhD.
Emeritus Scientist, National Water Research Institute
Environment Canada

August 4, 2001

The response to the STAP Reviewer's comments is presented below in italics and is organized according to numbering in the Reviewer's submission.

1. General Comments and Overview

This Project Brief (PB) is especially well prepared, comprehensive, and contains all the information that one would expect in a GEF application. In some respects, the PB is perhaps too comprehensive as it tends to be repetitive. Also, certain points tend to get lost in the text. Given the size of the PB (88 pages), it would be improved with a Table of Contents.

A Table of Contents has been included in this Project Brief.

This technical review includes a focus on certain aspects that, in the opinion of this reviewer, require some brief explanation and which may serve to clarify these issues in the mind of the GEF Council.

The only significant deficiency in this PB is the absence of hard data on the problems of the aquifer. This leads to certain technical questions raised below. Recognising that the TDA will deal with this in greater detail, one might, however, expect a brief technical summary of what is known (and not known) about the aquifer, as a basis for justifying some of the actions proposed. (refer to section 4 below).

2. Relevance to GEF

This project clearly fall within that set of criteria defined by International Waters. It is particularly gratifying to see a project come forward that is anticipatory rather than

remedial in its major dimensions. This should be encouraged where important transboundary issues are in play.

3. Objectives

The proposed objective are clearly stated and are entirely appropriate to the nature of the issue and the range of solutions that are realistic and implementable.

The objectives are well focused in the PB, and are certainly achievable given the caveats and implementation schedule proposed. The PB is particularly well focused on the scheduling of related activities and has a realistic view of what is achievable in the timeframe available. The Project proponents clearly have much experience in this area. There are no objectives that should be changed and none of consequence that should be added.

4. Approach

The approach to this project (the six [+ administrative] components) is clearly defined and appears to be technically sound (given the absence of hard technical information in the PB). The implementation steps and related technical detail outlined in Annexes 1 and 2 seem reasonable.

As noted below, certain aspects of this approach would benefit from some explanation.

- a) The fact that the TDA is not listed in Annex 1 as a major activity seems strange (compare with the SAP which is clearly noted).
- b) It is not clear to this reviewer how the project components are sequenced relative to the production of the TDA and the SAP (ref. Annex 2, Component 2) which are, it seems, major outcomes of this project (one learns this on page 33).
- c) It would be useful to have an explanation of how the substantive components of this project differ from (or link to) what would be recommended in the SAP (once it is developed). In other words, some of the components are what one would expect to see in the SAP, but appear here to be implemented prior to development of the SAP.

For example:

Component One presumably, is critical to both the TDA and SAP, yet neither are mentioned on page 12.

Component Two: how does this differ from what one would expect as a recommendation of the SAP, when it is developed.

4.a),b),c) One of the innovative concepts of this project is related to the fact that it does not only focus on studies and preparatory activities during the four years of its implementation, but that it provides some action from the beginning in order to maintain and maximize stakeholders'

interest. This is in line with the recommendations at the First GEF International Waters Conference in Budapest in October 2000 during which it was pointed out that SAP and TDA formulation periods have been too long in a number of GEF-supported International Waters projects. It is especially reflected in components 1 and 5, which will provide more information about the aquifer system and help implement pilot activities. At the same time, it cannot be expected that within four years everything would be known about this large groundwater body, nor that a full institutional/legal framework would be in place. In fact, the project explicitly states that the objective is to reach a consensus proposal for such framework. Therefore the SAP will have to make use of the results of the different components, which will provide both lessons learned, identification of knowledge and action gaps, as well as needs for future financing of identified activities. The TDA is considered a part of the SAP process and therefore does not appear as a separate component in Annex 1. It is mentioned as a part of the SAP in both Annexes 1 and 2. It will, however, constitute a monitorable line item of its own in the terms of reference for the SAP.

- d. Transboundary Issue: The transboundary nature of this project seems to be based mainly on the fact that the aquifer is shared by four countries. However the project document does not demonstrate that there is, in fact, a transboundary threat or to what extent a common approach to management is essential. The real question, and which presumably will be answered in the TDA will be the extent to which threats in one country (e.g. groundwater contamination around Sao Paulo) have the potential to damage quality and quantity in adjacent countries. This seems to be assumed in the PB. A common management approach is only required when it can be demonstrated that a threat in one country constitutes a threat in adjacent countries. If this cannot be established, then a common approach to monitoring and evaluation would be the main focus.

4 d) It has been established through technical studies that clear transboundary issues exist in the border areas of Argentina/Uruguay (well yields are diminishing and some cross border disputes are apparent due to the importance of these geothermal wells for tourism) and Uruguay/Brazil (pollution between sister cities across the border). The nature of the aquifer system, i.e. very large volumes of mainly confined aquifer storage compared to significant – but smaller and much more localized – volumes of active recharge, mean that there is a possibility that major development could provoke large drawdowns with the potential for conflict between competing users. This is the more significant, given the fact that the most valued exploitation is in the form of ‘overflowing geothermal wells’ and conservation of such artesian heads is managerially more demanding than normal aquifer management.

In addition, the recharge area in Paraguay, bordering Brazil and Argentina, is a potential area for transboundary impact. These three areas have been included as Hot Spots to be addressed by the project. In addition, the area of São Paulo is the one experiencing the most extraction and pollution in the entire aquifer system area. While it is highly unlikely that pollution in São Paulo would reach the other countries, the technical and institutional assessments have shown that this area can provide important lessons in terms of decentralized management and monitoring approaches. All four countries agree that the institutional management framework for the Guarani Aquifer System needs to be as light as possible, precisely due to its size. Therefore it will be necessary to test which types of measures will work in border areas and also in areas of significant national importance. This information has been added to the Project Brief.

Other related environmental issues:

- e. Surface and Groundwater linkage: The linkage between this project and surface water management is important, especially in the context of an absence of common management practices (especially in water quality management) for the Paraná River Basin which is also common to all four countries and overlies, more or less, the Guarani Aquifer. Also, some countries, such as Argentina, have very poorly developed legal approaches to water quality objectives or standards for controlling effluents for surface water. How will this lack of a legal framework for surface water management affect this much more complex task of developing legal criteria for managing groundwater? Have the proponents of this project considered what linkages are necessary between surface and groundwater management at the transboundary scale in order to ensure success of this particular project? More pointedly, can the groundwater component proceed in the absence of a suitable parallel framework for surface water quality management? The linkage between this and other CAS projects has not been made.

A related issue is the linkage between increasing use of groundwater when, in fact, there is much surface water. Is better surface water management part of the solution? It seems hard to image that surface water management will not be part of the overall management plan.

4 e) 90% of the Guarani Aquifer System is confined and 10% constitute recharge areas. Thus, given the geomorphology and hydrogeology of the area there are few locations where surface watercourses are recharging the unconfined aquifer system. For this reason the interaction between ground- and surface water is strongly limited in most of its reach. It means that management can be tackled semi-independently of that of surface water. One of the results of the project, especially Component 1, will be a clearer knowledge about the recharge areas, which are not completely defined as yet. A major effort will be made, for instance, in the border area in Eastern Paraguay to model surface/subsurface interactions. It is anticipated that these results will provide the information necessary to design appropriate mechanisms for the interaction with relevant surface water areas. – An issue of importance is the role and significance of the aquifer system in providing baseflow to river systems (especially the Rio Uruguay) and sustaining wetlands in Misiones and Corrientes Provinces of Argentina, which is an important unknown in terms of international waters, but will be under investigation in the project. .

- f. Perhaps I missed it, but I do not see reference to the determination of allowable (sustainable) yield as one of the main technical outputs.

4 f) Given the complexity of this aquifer system, quantity is an issue in some parts (e.g. Uruguay/Argentina; São Paulo), but less in other – less developed – parts. Based on the technical assessments to be carried out during the project, sustainable yield estimates would be one of the outputs for subareas of concern.

- g. The reference to a GIS system (e.g Annex 2 : Component 2b) should focus on an Information System and not a GIS system. GIS is only one of the necessary tools in such a system. For example, GIS does not handle documents (required in this project); GIS does not do decision-support (undoubtedly will be required). GIS systems are poor at numerical analysis and numerical modelling (required for this project).

4 g) In Spanish/Portuguese, the Information System will actually be called SISAG (Sistema de Información del Sistema Acuífero Guaraní), for the reasons correctly pointed out by the reviewer. This has been adjusted in the Project Brief.

- h. Beneficiaries: I did not see any reference to use of the aquifer for agricultural (irrigation) purposes. Perhaps there is no such use. If there is, then this use should be identified and quantified, as it may be the most intractable management issue. A related issue is the contamination of groundwater by agriculture, especially by nitrogen which is usually the most widespread of groundwater contaminant in America and Europe.

4 h). This issue will be addressed in Component 1.4 (see Annex 1) “Water quality is assessed and pollution patterns distinguished in terms of the origin, impacts and ways to remediate pollution”. As mentioned in the same paragraph, this will also include recharge/discharge areas where irrigation may play a major role.

- i. Annex 7 – Root Cause - issue is not that WB has/has not a policy on groundwater, but what are the institutional frameworks that already exist elsewhere and which may work here. Reference to the UN’s transboundary water convention would be useful.

4 i) The fact that the World Bank does not have a policy on groundwater was mentioned in the context of useful lessons to be learned from this project as to future endeavors in other countries, in which the World Bank may be involved. It is not mentioned as a root cause. As to general international legal frameworks, the UN transboundary water convention is only of limited use, given that it does not include confined aquifers. As previously noted, the Guaraní Aquifer System is 90% confined and only 10% free, thus constituting a hybrid case, for which innovative measures will have to be sought. The guidance from the Convention will be taken into account as appropriate.

Root Causes (Para 4) : these are almost never quantifiable and it would be unwise to offer this as an output. In some respects, the “root cause” analysis is less appropriate for this study, than a “threat analysis” in that the system seems to be not yet severely impacted.

4 i) The correct wording should have been “The root causes of existing and potential problems will be identified during this project.” The sentence has been corrected in the present Project Brief.

- j. Transboundary Diagnostic Analysis (TDA). This is a key activity that is too often done poorly. A high degree of rigour, discipline, and technical oversight, needs to be brought to bear on this activity. This activity should lead to a “threat analysis” and not solely to a diagnostic analysis (what, where, when).

4 j) See response to comments 4 a),b),c)

- k. Process Indicators:

- What is the probability of obtaining a four-country agreement on management of the Aquifer?

- “the existence of a functioning monitoring network” - this needs to include an harmonized monitoring network based upon agreed priorities and using modern principles of groundwater quality monitoring. (not so easy as it sounds as it includes, amongst other things, international acceptance of a common standard for data quality).
- While a legal framework is required, an indicator should reflect the willingness of the participants to enforce this legal framework (legal frameworks are common in Latin America, but willingness or ability to enforcement is less so).
- Following the TDA there needs to be some assessment of the capacity (technical and institutional) of each country to carry out the work that is identified, and what capacity development may be necessary to overcome any identified deficiencies. As an example, Brazil is said to have the technical capacity to analyze only 30% of the active ingredients of pesticides used in that country.

4 k) The probability that the countries will come to a consensus proposal is high. Given that the final adoption of any legal framework is dependent on the governments and legislature of each country, the project does not have the actual adoption as one of its outputs. It will be one of the challenges of the project to design a framework that is light and therefore feasible in order to increase the likelihood that legal and institutional agreements are followed up in practice. An important design feature of the project is to include subnational levels of government as well as other stakeholders (academia and other civil society groups). This is expected to help disseminate project results and hopefully generate pressure to comply with jointly agreed actions, such as joint monitoring standards. A capacity assessment was carried out during project preparation and a more in-depth assessment will be part of project implementation.

l. Stress Reduction Indicators

“identified and quantified water quality threats and their evolution” - should this not be “evaluation” rather than evolution?

4 l) Evolution in this context refers to forecasts about the future developments of these threats (stable, increasing, etc.)

m. Environmental Status Indicators:

“implementation of an up-to-date, functioning GIS...” This should focus on an “information system” and not GIS per se. (or a GIS-based information system)

4 m) See response to comment 4 g)

5. Background Information

Annex 6 (Aquifer Description) – more detail would have been useful. This is very short and not very complete. Eg. in Annex 6 and 7, and elsewhere, document says that “significant pollution” is occurring -- A fuller description would have been useful. Eg. what is known about pollution of aquifer – microbiological (municipal, animal wastes)? industrial contaminants? (See para. 3.5.) Agricultural (especially N); etc. Root Cause analysis focuses on pollution status and degradation potential (Para. 3). Is this hearsay

evidence or hard evidence? Or does it fall into the category that it has been said so many times that everyone believes it.

Generally, the PB provides little technical information nor cites informed sources to justify some of the central claims. This is NOT a major oversight insofar as detailed technical information is usually lacking in such situations, however something MUST be known about the aquifer in order to initiate country actions to involve the GEF on this issue.

5. Further information on the aquifer characteristics has been added to Annex 6 of the Project Brief in response to this comment.

6. Funding Level

Relative allocation of funds amongst the various components seems reasonable, although I personally believe that not more than 10% of the total should be devoted to project management per se (here, 13%). The total amount seems reasonable given the major activities anticipated.

6) Given the regional nature of this project (and large geographical area that it covers, with numerous local stakeholders) the project coordination activities are considered both critical to the project's success and necessary to be well funded in order to achieve their objectives. We feel that the proposed allocation is well justified based on the needs of this type of project.

What is the potential of default by Argentina on promised counterpart funding under this economic climate?

The project will be included in the national budget. In addition, a significant part of Argentina's contribution will be in kind.

7. Innovation

The action of developing an international management plan for a major aquifer will be truly innovative, and will provide a useful example for other similar problems world-wide.

The fact that the GEF does not fund research, the need to gather information and carry out investigations is an ESSENTIAL part of this project. It is this reviewer's opinion that many GEF projects suffer because of an assumption that new knowledge is not needed to bring the project to a successful conclusion. It is gratifying to see that a significant proportion of the budget is targeted to this activity.

(This summarizes comments which have been responded to above).

8. Strengths/Weaknesses

The greatest strength of this project is the ability to take proactive action against future degradation threats.

In my view, the PB is mainly weakened by the lack of evidence to support the supposition that there are threats (especially contamination issues) which are transboundary in nature. Also, the lack of linkage with surface water quality management would appear to be a weakness. Neither of these are, however, reason to cause the proponents to develop a new strategy – only that some explanation would improve the quality of this proposal.

9. Conclusion

This is thoughtful, comprehensive, and well designed project. The proponents are to be congratulated. The risks are transparent and manageable. While some limited weaknesses are apparent it is highly likely that a brief explanation will put these matters to rest. This is an excellent example of use of the GEF for pro-active purposes and should be greatly encouraged.

ANNEX 13 MAP