INSTITUTO MEXICANO DE TECNOLOGÍA DEL AGUA

INFORME FINAL

"ELABORACIÓN DE DOCUMENTOS DEL PROYECTO RIO BRAVO – GLOBAL ENVIRONMENTAL FACILITY"

TH1011.4

Junio de 2011

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CONTENIDO

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NOMBRE OFICIAL DEL PROYECTO: "REGIONAL FRAMEWORK FOR SUSTAINABLE USE OF THE RIO BRAVO",

1. **Objetivo original del proyecto.**

Elaborar un documento para mejorar el manejo sustentable de los recursos naturales en la Cuenca del rio Bravo, desde un punto de vista binacional, que recopile la experiencia y resultados de estudios anteriores en la zona, y con base en un plan de acciones estratégicas, proponer las acciones tanto estructurales como no estructurales que permitan mejorar las condiciones actuales de los recursos naturales en esta cuenca binacional, incluyendo la generación de una serie de escenarios prospectivos bajo los efectos de cambio climático. El IMTA participó en la elaboración de dos documentos en particular, referidos en el anexo 1 y anexo 2 de este informe. Estos anexos forman parte del paquete completo que fue sometido para su aprobación por parte del Secretariado del GEF.

2. **Etapas originales del proyecto.**

Se solicitó el financiamiento al Global Environmental Funding (GEF) para la ejecución del proyecto, a través del PNUMA como agencia implementadora y la OEA como agencia ejecutora. Se tenían contempladas cinco componentes del proyecto en la propuesta original, que incluye la elaboración de un programa de acciones estratégicas, análisis y diagnóstico para mejorar el manejo de los recursos naturales desde un punto de vista binacional, un mejor entendimiento de la cuenca, y el aspecto administrativo y financiero. El gobierno Mexicano, a través de la SEMARNAT – IMTA, participó en la revisión de los términos de referencia de cada componente del proyecto, y la elaboración de dos componentes en particular incluidos en los anexos 1 y 2 del presente informe; mismos que fueron el sustento técnico para la solicitud de los fondos ante el GEF.

3. **Equipo de trabajo.**

Para el planteamiento y ejecución original del proyecto, se consideró la participación de la Universidad de Texas en San Marcos y la EPA por parte de los Estados Unidos. Por parte de México, el líder original del proyecto era la SEMARNAT, a través de la oficina del Dr. Antonio Díaz de León – Dirección General de Política Ambiental e Integración Regional y Sectorial -, fungiendo el Instituto Mexicano de Tecnología del Agua, a través de la coordinación de Hidrología, como facilitador técnico para la generación y revisión de los documentos originales del proyecto sometido para la aprobación del Secretariado del GEF.

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ANEXO 1. Sub-project II.2 Integrated Information System

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PART 1

PROJECT IDENTIFIERS

Sub-project II.2

Integrated Information System

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1.1 Sub-project title
Integrated Information System

1.2 Link to umbrella project
This Subproject II.2 is linked to nearly all activities of the Project. Indeed all information and data generated under the other subprojects will be used to populate the Basin-wide information system to be developed herein.

1.3 Geographical scope
Rio Grande/Bravo River Basin (United States of America; Mexico)

1.4 Executing agency/entity
Specialized research institution or project execution team (to be identified and selected by a request for proposals), working in close coordination with the Project Coordination Unit (PCU) and in collaboration with National Project Units, under the oversight of the Implementing Agency (IA).

1.5 Duration
24 months

1.6 Focal areas
International Waters

1.7 GEF grant
US$ 300,000

1.8 Co-financing
US$ 358,668

1.9 Total funding
US$ 658,668

1.10 Associated financing
US$ XXX

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1.11 Contact person

1.12 Project summary

This sub-project is designed to improve the water data exchange between Mexico and the United States in the Rio Bravo/Grande basin, by updating and completing the Water Management Information System in which most of the water quantity, quality, and groundwater data for this binational basin are included in a geographically referenced bilingual relational database (i.e. a geodatabase).

In this sub-project, agencies from Mexico and the USA will cooperate to build on the results of the previous research in the basin, achieved by other Mexican and American agencies under different binational programs such as the Border 2012 program or U.S. – Mexico Border Environmental Health Initiative to accomplish three tasks:

(1) Update the existing relational database – geodatabase - for the Rio Bravo basin, including both water quantity and quality data;
(2) Create a geodatabase of groundwater information for aquifers in the Río Grande/Bravo basin;
(3) Create a platform to share the temporal and spatial information through Internet. This platform could be a multiuser server to allow access for multiple users simultaneously

This project will assist Mexico to develop advanced capability to manage critical water resources in the rio Bravo/Grande basin shared with the US and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues.

Activity	Output	Outcome
1. Design and Implementation of the Integrated Information System, following the structure used by the USGS and the Mexican National Water Commission, such as the relational database (Geodatabase)	A bilingual relational database (geodatabase) for the Rio Bravo/Grande basin including both water quantity and quality data, as well as groundwater information from both sides of this binational basin. Both temporal and spatial information related to all thematic layers will be included in a Geographic Information System,	Improve capability to manage critical water resources in the rio Bravo/Grande basin and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues.
2. Create a platform to share the temporal and spatial information	WEB application for accessing the geodatabase and to show the results in a viewer	Improve access to information of federal and state agencies in both sides of the rio

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through Internet. This platform could be a multiuser framework implemented in ArcGIS Server, who is a platform used by American and Mexican Agencies.	implemented in Internet.	Bravo/Grande basin.

Activity	Sources of funding				Total Cost (US$)
	GEF Funding (US$)		Co-financing (US$)		
1. Design and Implementation of the Integrated Information System, following the structure used by the USGS and the Mexican National Water Commission, such as the relational database (Geodatabase)	$200,000	52.72%	$179,334	47.27%	$379,334
2. Create a platform to share the temporal and spatial information through Internet. This platform could be a multiuser framework implemented in ArcGIS Server, which is a platform used by American and Mexican Agencies.	$100,000	35.80%	$179,334	64.20%	$279,334
TOTAL	$300,000	45.54%	$358,668	54.46%	$658,668

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PART 2

PROJECT DESIGN

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2.1 Background and context

The Rio Grande/Bravo is a transboundary water source shared by the United States and Mexico. At this time, Mexico is in the process of improving its ability to develop and implement efficient management plans for the water in the Rio Grande/Bravo basin, taking into account the new developments in Mexican water law and the existing infrastructure and methods of application and distribution of water. A continually increasing population, serious problems related to lack of sanitation and clean water, as well as regular high investments in infrastructures which are not achieving their objectives, are likely to force governments at various levels to search for alternative approaches, other than relying only on engineering solutions through supply management alone. The institutions concerned are aware that successful water resources management requires a long term planning process from technical, economic, political, social, and environmental viewpoints.

In addition, some decisions about water management are only partially supported, causing alterations in the global ecosystem. For this reason it is necessary to improve the administration and management of water in this watershed. This requires an assessment of water availability and the means to manage it appropriately for agriculture, industry and other services, also taking into account ecosystem preservation.

The development of a watershed-scale database for the Rio Grande/Bravo basin is of critical importance. Minute 308 of the International Boundary Waters Commission (IBWC), June 28, 2002, states that it is very important to support projects that increase data exchange related to the management of hydrological information systems. These systems should include information from both sides of the basin in a timely manner to enable the IBWC to adopt principles and understandings under which both Governments provide the highest priority to fulfilling their respective obligations under the 1944 Water Treaty.

Also, the border of Mexico and the U.S., the fastest growing region in North America and one of the regions of highest economic development and growth in Mexico, has several critical, shared river basins and aquifers. These transboundary water sources shared by the United States and Mexico are the lifeblood for much economic activity on both sides of the border. Recently, the several highly developed water resources and decade-long drought conditions have created tensions over water sharing in the region. Areas of conflict and several possible negotiated remedies are being identified, but access to reliable data for analysis of alternative solutions to these problems is lacking. This project will help to solve the fundamental problem of making accurate data available for decision makers in the rio Bravo/Grande basin as well as the other components of the project. These data are being provided in the industry-standard ArcHydro geographic information system (GIS) which provides ready access to data for hydrologic and policy analysis using a wide variety of hydrologic, water quality, economic, and environmental models. ArcHydro makes it possible to store information about a river basin in a way that resembles the physical geography of the real basin, so that you can analyze effects from upstream or on downstream in a connected manner.

In addition, recent studies have shown that there is a lack of access to data regarding water quality in the rio Bravo/Grande binational basin. This has prevented progress

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in analyzing the effects of investments in water quality improvement infrastructure in this area. There is a critical need to have water flow and quality data available in a form that support the development of water quality models for this region. This project will create links between the developed geodatabase and standard practice water quality and quantity models for this critical basin.

As the border region develops, there is increasing pressure to develop further the groundwater resources of the rio Bravo/Grande basin. At the present time, there is little data on the extent and availability of groundwater in this basin. In this project, information about these critical resources will be compiled into a geodatabase for use in water availability studies.

2.2 Sub-project objective

Development of a Geographic Information System to (i) store, organize and classify all incoming data and information in at least 15 different *thematic layers* into a bilingual relational database following the ArcHydro structure using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side, and also based on an inventory of kind of existing geodatabases and common platforms used by American and Mexican agencies in charge of management of geographic and water information, such as relational geodatabases, shapefiles, file geodatabases, etc. Also this GIS will include sixteen digital elevation models covering the whole basin, seven on the Mexican side and 9 on the American side according to the official classification in both sides of the basin (ii) create a *platform* linking thematic databases, metadata catalogues, models and user interfaces within a WEB interface to offer a *user friendly gateway* for decision-makers, stakeholders, governments, private institutions and the public in general to access all available data and information of the Rio Bravo/Grande basin. This platform will work as a multiuser framework to allow the simultaneous access for the decision makers.

2.3 Environmental benefits

The biodiversity of the Bravo/Grande River basin has to be considered also. The basin supports many threatened and endangered species: water development projects have seriously disrupted natural flow regimes, affected wetlands and aquatic fauna, and degraded native riparian plant communities. The development and documentation of a sound technical and scientific understanding of the issues of concern facing the Rio Bravo/Grande basin is a priority step for formulating appropriate and relevant responses to environmental and related socio-economic concerns in the Basin. During the project development phase, it became clear that considerable scientific effort has been devoted to attempting to understand elements of the Rio Bravo ecosystems and their associated hydrological and biogeophysical elements. Much of this effort is documented in technical and scientific journals, professional documents, reports, proceedings of meetings, and other literature. However, although much of the scientific effort has focused on specific aspects of the river system, particularly its hydrological and biodiversity characteristics, or on specific areas of the system, little effort has been made to integrate this information

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into a detailed understanding of the basin as a whole.

2.4 Overall sub-project outcomes

The outcomes for the Mexican part of the rio Bravo/Grande basin will be i) Improved capability to manage critical water resources in the rio Bravo/Grande basin and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues; using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side, and also based on an inventory of kind of existing geodatabases and common platforms used by American and Mexican agencies in charge of management of geographic and water information,
ii) Improved access to information of federal and state agencies in both sides of the rio Bravo/Grande basin, thought and Internet interface implemented in a standard multiuser platform, such as SQL server, and linked to the Geographic Information System for managing temporal and spatial information

2.5 Consistency of the sub-project with national/regional priorities and plans

Many regional and national priorities and plans that focus on the rio Bravo/Grande basin are encompassed within ongoing activities of the two riparian countries, and which are consistent with the goals of this sub-project, as follows:

Regional

A) International Boundary and Water Commission (IBWC; the Mexican section of IBWC is the Comisión Internacional de Límites y Aguas (CILA)): The IBWC is a binational body responsible for applying the boundary and water treaties between Mexico and the USA, and settling any differences that may arise in their application. Its mission is to apply the rights and obligations assumed by Mexico and the United States under numerous boundary and water treaties and related agreements in a way that benefits the social and economic welfare of the peoples on both sides of the boundary and improves relations between the two countries, including such issues as boundary demarcation, national ownership of waters, sanitation, water quality, and flood control in the border region.

B) Border 2012 Program: The 1983 Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (La Paz Agreement) is the legal basis for this binational collaborative programme. With active participation of 10 Mexican and US border states, and US tribal governments, the US Environmental Protection Agency (EPA) and Mexico's Secretary of Environment and Natural Resources (SEMARNAT), in partnership with the US Department of Health and Human Services (HHS), the Mexican Secretary of Health (SS) and other federal agencies, the goal of the Border 2012 Program is to improve the environment, and protect the health of people living along the common border, consistent with principles of sustainable development. The program focuses on providing safe drinking water, cleaning the air, reducing risks of exposure to hazardous waste, and ensuring emergency preparedness along the border region.

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C) Border Environment Cooperation Commission (BECC): The BECC is a binational organization created by the Mexican and US Governments under a side agreement to the North American Free Trade Agreement (NAFTA). BECC's mission is to help conserve, protect and enhance the environment in the Mexico-US border region, through developing and certifying environmental infrastructure projects incorporating innovative sustainability and public participation concepts. BECC's mandate addresses water pollution, wastewater treatment, and municipal solid waste management projects, including issues such as hazardous waste, water conservation, water and sewer system hookups, and waste reduction and recycling. Air quality, transportation, clean and efficient energy, and municipal planning and development projects (including water management) have subsequently been added to BECC's mandate.

D) North American Development Bank (NADBank): The NADBank is a binational organization created by the Mexican and US Governments under another side agreement to the North American Free Trade Agreement (NAFTA). The NADBank is a binational financial institution capitalized and governed equally by the United States and Mexico for the purpose of financing environmental projects certified by the Border Environment Cooperation Commission (BECC). The two institutions work together with communities and project sponsors in both countries to develop and finance infrastructure necessary for a clean and healthy environment for border residents.

National

Mexico:

A) Secretary of Agriculture, Cattle Raising, Rural Development, Fishing and Nourishment (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, SAGARPA): In 2003 SAGARPA launched the *Water Rights Adjustment Program* (WRAP)[1] (Programa de Adecuación de Derechos de Uso del Agua, PADUA, for its Spanish acronym) in order to reverse the detrimental effects of over concession and over exploitation of water resources. The objective of PADUA is to promote the sustainability of irrigation systems as well as river basins and aquifers, based on datasets available. The main thrust of PADUA is to recover water use rights in exchange for direct financial support in order to modernize irrigation techniques or simply recall water use rights from idle lands, precisely what Activity III.2.1 proposes to focalize in the Bravo River basin.

[1] Asad, M. and H. Garduño, *Water Resources Management in Mexico: The Role of the Water Rights Adjustment Program (WRAP) in Water Sustainability and Rural Development*, World Bank, Washington, D. C., 2005, 73 pp.

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B) National Water Commission (Comisión Nacional del Agua, CONAGUA): CONAGUA is the only Mexican authority empowered to manage and preserve the national waters (when they are in its physical environment), with participation of society, in order to achieve the sustainable use of water resources. This includes the granting of water use rights, the regulation of uses and users and fiscal attributions to charge for water abstraction. CONAGUA has, among many others, the Program *Sustainable Use of Water in the Bravo River Basin* (Programa Uso Sustentable del Agua en la Cuenca del Río Bravo[2]), whose main objective is to attain the water sustainability through modernization of hydro-agricultural infrastructure and the introduction of more efficient techniques in lot irrigation. Also, under the National Water Program 2007-2012 of Mexico, CONAGUA evaluates the requirements of the water sector; to promote the descentralization of functions to the local level, to propose necessary modifications to the law on National Waters and its Regulations; and to establish the National Water Information System.

C) Secretary of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales, SEMARNAT): A ministry of the federal government, SEMARNAT is responsible for establishing the environmental protection policies to reverse ecological deterioration and promoting the basis for sustainable development in Mexico. A program directly related to Activity II.2 is the *National Water Program 2007 - 2012* whose main objective is to contribute to achieve the country's environmental sustainability through responsible participation in the care, protection, preservation and rational use of the natural resources in order to strengthen the economic and social development, without compromising the natural legacy and the life's quality of future generations; providing data on natural resources and the environment in the National Water Information System.

United States:

A) U.S. Environmental Protection Agency (EPA): The EPA was established in 1970 as a federal response to growing public demands for cleaner water, air and land. The concerns of EPA's Region 6 encompass the US portion of the Rio Grande Basin, including facilitation of construction of wastewater and drinking water facilities for people living in unincorporated areas (colonias) along the US side of the border. The EPA also works with other federal, state and local agencies to help identify and solve border environmental problems.

B) Rio Grande Watershed Federal Coordinating Committee (RGWFCC): The RGWFCC is a consortium of 11 US federal agencies, including the US section of IBWC, National Park Service, EPA, Army Corps of Engineers, Bureau of Reclamataion, Department of Agriculture, Bureau of Indian Affairs, Bureau of Land

[2] [Mexican] National Water Commission, *Program "Sustainable Water Use in the Bravo River Basin: White Book"*, Mexico City, Mexico, 2006, 76 pp. (In Spanish).

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Management, and National Weather Service. Its purpose is to facilitate familiarity of these agencies with each other's responsibilities and ongoing projects related to watershed planning activities relevant to the Mexico-US border, and facilitate opportunities for interagency collaboration.

C) U.S. – Mexico Border Environmental Health Initiative project. The USGS U.S.-Mexico Border Environmental Health Initiative (BEHI) recognized the need for development of transboundary datasets, standards, and web mapping services under the guidance of multi-disciplinary researchers and in close collaboration with Federal entities in both the U.S. and Mexico, such as the Mexican Geography and Census Bureau (INEGI) and the International Boundary and Water Commission (IBWC)

2.6 Consistency of the sub-project with the GEF strategies and its strategic programmes

This sub-project is consistent with long term Strategic Objective 2 of the IW GEF-4: to catalyze transboundary action addressing water concerns, and with Strategic Program 3: balancing overuse and conflicting uses of water resources in surface and groundwater basins that are transboundary in nature.

2.7 Coordination and linkages to the umbrella project activities and other related activities in the basin

The overall objective of the umbrella project is to create a framework for the sustainable management of the Rio Grande/Bravo River basin waters. This includes the understanding of the basin's society and natural resources, in both sides of the border, on which to base the response strategies. The sub-project II.2 composed of a Integrated Information System, is part of those response strategies to be integrated, altogether with all activities in the project.

2.8 Incremental reasoning

Baseline

Recent drought conditions have increased tensions over water sharing in the Rio Bravo/Grande basin. Several areas of conflict and possible negotiated remedies have been identified, but there is a lack of data available to use in analysis of alternative solutions to these problems.

The development of a watershed-scale database for the Rio Grande/Bravo basin is of critical importance. Minute 308 of the IBWC, June 28, 2002, states that it is very important to support projects that increase data exchange related to the management of hydrological information systems. These systems should include information from both sides of the basin in a timely manner to enable the IBWC to adopt principles and understandings under which both Governments provide the highest priority to fulfilling their respective obligations under the 1944 Water Treaty.

In this research project, specialized research institution or project execution team (to be identified and selected by a request for proposals), working in close coordination

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with the Project Coordination Unit (PCU) and in collaboration with National Project Units, under the oversight of the Implementing Agency (IA), will cooperate to update and complete a bilingual relational database containing geographic, hydrologic, water quality, hydraulic and related data for the rio Bravo/Grande basin. This geographically referenced database would be updated using the ArcHydro data model for the entire Rio Grande/Bravo basin, and followed a standard platform, such as relational datasets called geodatabase, used by the main agencies in charge of water and geographic information on both sides of the basin.

Increment

The development of a watershed-scale database is fundamental to analyzing water resource management problems in the Rio Grande/Bravo basin. Even though separate research efforts have been carried out on each side of the river, an integral database that includes data from both sides of the basin needs to be updated and completed. As in many watersheds, knowledge and information available about the Rio Grande/Bravo basin is fragmented, disjointed, incomplete, and sometimes inaccurate. Integrated management of a river basin requires the development of models that are used for many purposes, e.g., to assess risks and possible mitigation of droughts and floods, manage water rights, assess water quality, and simply to understand the hydrology of the basin. For this purpose an updated database is needed from which models can access the various data needed to describe the systems being modeled. In other words, a database from which models read input data and to which they write output data. In order for this concept to work, however, it must have a standard design. The recently developed ArcHydro data model facilitates access to hydrologic information by models.

Alternative

Under the alternative scenario, the Basin is instrumented and equipped in such a way as to not only provide the information necessary for country-based decision making and enforcement activities, but is monitored with a view to making data available for such activities that impact the binational basin as a whole. In terms of this alternative system, data are acquired, disseminated, and utilized by a variety of stakeholders and shared between agencies, organizations and others. In order to overcome the limitations of the traditional hydrometeorological, hydrometric and water quality stations, it is important to incorporate at least all available data in just one site, from where modelers and decision makers could access to the same information. —

Incremental reasoning

Creating an ArcHydro geospatial database for the entire Rio Grande/Rio Bravo basin represents the first major attempt to establish a more complete understanding of the basin as a whole, using both Mexican and U.S. geospatial and temporal data for water resources. It is possible to obtain from the database information about climatology, water availability, water quality, water uses, hydraulic infrastructure, and drainage in the basin that are included as feature classes within the bilingual relational database. These data will permit models to calculate the state of water availability under different climatic and development scenarios and management plans in the future.

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2.9 Activities, outputs, outcomes

Activity II.2.1 Design and Implementation of the Integrated Information System

(1) Objective:

Update and complete the binational geodatabase for the Rio Bravo/Grande basin, including both water quantity and quality data as well a geodatabase of groundwater information for aquifers in the Río Grande/Bravo basin

Activities: i) In updating and completing the geodatabase for the Rio Grande/Bravo basin, data distributed on a national or state level have to be clipped to remove information outside the study area; while data distributed at a county or Hydrologic Cataloging Unit level, had to be merged into a single and larger data set. ii) Entering and processing the available information into the ArcHydro Rio Grande/Bravo geodatabase. Several feature datasets (essentially, sets of data with specific characteristics in the geodatabase) would be created that include feature classes (layers of data within the feature datasets) related to each type of information. When working with huge basins like the Rio Grande/Bravo basin, computer processors are not always able to handle the large raster datasets. This is handled by dividing the basin into sub-regions and processing the rasters individually for each sub-region. Then the values obtained for each sub-region can be cascaded downstream to get the final parameters for the entire basin, iii) blueprint elaboration.

Outputs: A bilingual relational database (geodatabase) for the Rio Bravo/Grande basin including water quantity and quality data, as well as groundwater information from both sides of this binational basin; using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side, and also based on an inventory of kind of existing geodatabases and common platforms used by American and Mexican agencies in charge of management of geographic and water information, such as relational geodatabases, shapefiles, file geodatabases, etc. Also this GIS will include sixteen digital elevation models covering the whole basin, seven on the Mexican side and 9 on the American side according to the official classification in both sides of the basin

Outcome: Improve capability to manage critical water resources in the rio Bravo/Grande basin and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues.

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Funding summary:

Total Cost USD $379,335– GEF Grant USD $200,000 – Co-financing USD $179,334

Activity II.2.2 Create a platform to share the temporal and spatial information through an Internet portal

Objective: **Creation of a WEB platform linking databases, metadata catalogues, models and user interfaces** spread throughout the rio Bravo/Grande basin within a Geographic Information System (GIS).

Activities: i) undertake national surveys to identify, analyze and select local databases and information sources which will be linked to the platform, (ii) establish national nodes to centralize the databases and information at the basin level. iii) develop the WEB platform to link the different types of databases, through national nodes, and the interface with the GIS, and using a multiusers environment.

Outputs: WEB application for accessing the geodatabase and to show the results in a viewer implemented in Internet. This platform could be a multiuser framework implemented in ArcGIS Server, which is a common platform used by American and Mexican Agencies.

Outcome:
Improve access to information of federal, state agencies and academic institutions on both sides of the rio Bravo/Grande basin.

Funding summary:
Total Cost USD $279,334 – GEF Grant USD $100,000 – Co-financing USD 179,334

Subproject II.2 Integrated Information System	Indicator	Baseline level	Mid-term target	End-of-project target
Objective II.2 Improve the water data exchange between Mexico and the United States in the Rio Bravo/Grande basin, by updating and completing the Water Management Information System in which most of the water quantity, quality, and groundwater data for this binational basin are included in a geographically referenced bilingual relational database (i.e. a geodatabase).	Integrated Information System is created, containing at least 15 different thematic layers into a bilingual relational database following the ArcHydro structure using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side. sixteen digital elevation models covering the whole basin, seven on the Mexican side and 9 on the American side according to the	Federal, state and local agencies provide access to information at the national and/or local levels for this binational basin. Also, some databases exist from previous efforts in both countries.	knowledge of stakeholder and agencies information needs is being accumulated	Basin-wide information system is created and being populated

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This Geographic Information System will store, organize and classify all incoming data and information in at least 15 different thematic layers into a bilingual relational database following the ArcHydro structure using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side, and also based on an inventory of kind of existing geodatabases and common platforms used by American and Mexican agencies in charge of management of geographic and water information, such as relational geodatabases, shapefiles, file geodatabases, etc. Also this GIS will include sixteen digital elevation models covering the whole basin, seven on the Mexican side and 9 on the American side according to the official classification in both sides of the basin	official classification in both sides of the basin			
Outcome II.2.1: Improve capability to manage critical water resources in the rio Bravo/Grande basin and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues.	Water quantity, quality and groundwater data sources identified and data acquired for use in the integrated information system	Basin-level data available; basin-based data collection programs ongoing	Data needs are identified; data sources are identified	Data acquired in electronic format and "placed into" the integrated information system; standardized data collection and analysis protocols proposed
Outcome II.2.2: Improve access to information of federal and state agencies in both sides of the rio Bravo/Grande basin.	Integrated Information System is operational	Portal to access information created at the basin level, and supported by Mexico and the United States	Knowledge to exchange water information among agencies	Basin-wide information system is created and being populated
Output II.2.1: A bilingual relational database (geodatabase) for the Rio Bravo/Grande basin including both water quantity and quality data, as well as groundwater	Completion and update of a bilingual binational geodatabase that includes water quantity, quality and groundwater information	Information in different formats available at the Basin level	Current datasets in both countries are considered in order to be part of this Integrated Information System	Integrated information system created

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information from both sides of this binational basin				
Output II.2.2: WEB application for accessing the geodatabase and to show the results in a viewer implemented in Internet	Platform linking thematic databases, metadata catalogues, models and user interfaces within a WEB interface to offer a user friendly gateway for decision-makers, stakeholders, governments, private institutions and the public in general to access all available data and information of the Rio Bravo/Grande basin. This platform will work as a multiuser framework to allow the simultaneous access for the decision makers.	Limited access to the basin information through Internet	information needs assessment initiated	Internet portal is created for accessing water information.

2.10 Budget

Co-financing

Sources of Co-financing	Type of Co-financing	Amount
Project Government Contribution	In-kind	
Bilateral Aid Agency(ies)	(select)	
Multilateral Agency(ies)	(select)	
Private Sector	(select)	
NGO	(select)	
Others	In-kind	
Total co-financing		

Project management budget

Cost Items	Total Estimated person weeks	GEF ($)	Other sources ($)	Project total ($)

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Local consultants - *provide unit costs*				
International consultants – *provide unit costs*				
Office facilities, equipment, vehicles and communications – *please specify and provide cost breakdown and unit costs*				
Travel – please provide breakdown and unit cost				
Total				

Consultants working for technical assistance components:

Component	Estimated person weeks	GEF($)	Other sources ($)	Project total ($)
Local consultants - *provide unit costs*				
International consultants - *provide unit costs*				
Total				

Consultants to be hired for the project

Position Titles	*$/ person week*	*Estimated person weeks*	*Tasks to be performed*
For Project Management			
Local			
International			
For Technical			

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Assistance			
Local			
International			

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2.11 Timetable

Sub-project II.2 Integrated Information System	YEAR 01				YEAR 02				YEAR 03			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Activity II.2.1 Design and Implementation of the Integrated Information System												
Activity II.2.2 Create a platform to share the temporal and spatial information through an Internet portal												
Reports to the PCU												

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2.12 Cost-effectiveness

By focusing on the development of systems that can serve as the basis for sharing all types of data and information, investments in equipment can be minimized while at the same time maximizing access to knowledge. Similarly, the application of remote sensing technologies, for example, can provide access to large amounts of data at relatively low cost. By housing these data in accessible locations, for example within existing networks or by creating networks of existing data nodes, information can be utilized by a variety of users in making informed decisions regarding activities throughout the binational basin without each agency having to invest in the construction of data acquisition systems. By populating regional data distribution systems, and by providing the tools and routines necessary for a variety of stakeholders to access and use these data, agencies can provide the opportunity for enhanced decision-making at all levels, with concomitant benefits for the underlying ecosystem and natural resource base, across jurisdictional boundaries or frontiers. Timely knowledge can minimize financial risks and losses from pollution episodes, flood or drought events, for example.

2.13 Risk analysis

Risk	Rating	Risk mitigation measures
Agencies do not provide information and data to populate the information system	moderate	Involvement of Basin stakeholders; participation of governmental agencies
Users fail to access information or incorporate information into decision making	moderate	Inform stakeholders and agencies about the main objectives, procedures and status of the project, involving them in the process.
Federal, state and local agencies fail to allocate adequate resources to maintain information system	moderate	Tool for financial sustainability to be defined within the SAP (Component III.4)

2.14 Sustainability

The availability of knowledge, through inter alia the integrated informational system, and the active and responsible participation of all stakeholders in both the creation and dissemination of data and information, will contribute to ensuring that such data and information remain available for use in decision-making. Sound decisions will result in sustainable actions and activities being implemented within the rio Bravo/Grande basin. By coordinating this participation within the framework of an integrated information system that respects data and access to information, the designated basin management agencies will promote an integrated water resources

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management programs, plans, and decision-making practices, and their application throughout this binational basin.

2.15 Replicability

The Rio Bravo Basin represents a unique opportunity for the creation and implementation of a comprehensive binational water resources management framework within which states and countries can achieve varying measures of benefit, while, at the same time, achieving such benefits in a manner that fully recognizes and appreciates the aspects of national sovereignty, community-level economic and social development, and regional cooperation inherent in this project. The global interest in the rio Bravo/Grande basin further means that there is significant interest in the status of this binational basin not only from decision-makers and stakeholders, but other interested parties outside of the basin and around the both countries. A key element in achieving sustainable development and the integrated management of surface and ground water resources is the availability of information, and the availability of “real time” information that can support decision-making and emergency responses as well as satisfying the desire for knowledge by citizens, researchers, and others. Consequently, the creation and operation of an integrated information system, with graduated levels of access, can meet a variety of these informational needs, including those of the decision makers, and citizens within this basin of global importance. This Subcomponent supports that goal, and is built upon the experiences of others in assembling, disseminating, and operating information systems. In turn, this system can inspire others to develop similar systems and encourage the exchange and interchange of data and knowledge on a binational collaboration.

2.16 Execution arrangement

The Project Coordination Unit will assure that the project’s activities are executed according to the terms of reference in due time, under the oversight of the Executing Agency. The PCU will follow up the day-to-day activities’ execution and implement eventual corrective actions through a quality assurance and quality control program. In order to make sure that the best and updated scientific knowledge is applied throughout the sub-project the PCU will corroborate that all activities contain appropriate terms of reference and that the proposed consultants are well qualified.

2.17 Public participation mechanisms

This subproject is designed to develop and implement a knowledge base that comprises not only of information and data on water quantity, quality and groundwater but also of geo-referenced information and metadata on hydrographic and climatological parameters. Knowledge deriving from the utilization of available data and information will encourage public officials, legislators, and decision-makers to support and participate in water resource management practices and local and individual decision-making. The dissemination of these data and this information, in turn, will inform the public, agencies and other interested parties and stakeholder and facilitate their meaningful participation in basin management.

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2.18 Monitoring and evaluation

A set of performance indicators will be used to measure inputs, activities, outputs, outcomes, and impacts of sub-project activities. The indicators will be used to set up performance targets and assessing progress toward their achievement, and to flag the need for a follow-up review or evaluation of an activity.

The monitoring and evaluation system will be used to measure the quantity, quality and targeting of sub-project outputs, and to measure the outcomes and impacts resulting from these outputs. The system is also expected to be a vehicle to facilitate the understanding of the causes for good or poor performance.

Subproject II.2 Integrated Information System	**Indicator**	**Baseline level**	**Mid-term target**	**End-of-project target**
Objective II.2 Improve the water data exchange between Mexico and the United States in the Rio Bravo/Grande basin, by updating and completing the Water Management Information System in which most of the water quantity, quality, and groundwater data for this binational basin are included in a geographically referenced bilingual relational database (i.e. a geodatabase). This Geographic Information System will store, organize and classify all incoming data and information in at least 15 different thematic layers into a bilingual relational database following the ArcHydro structure using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side, and also based on an inventory of kind of existing geodatabases and common platforms used by American and Mexican agencies in charge of management of geographic and water information, such as relational geodatabases, shapefiles, file geodatabases, etc. Also this GIS will	Integrated Information System is created, containing at least 15 different thematic layers into a bilingual relational database following the ArcHydro structure using the 1:50,000 scale as minimum on the Mexican side, and 1:100,000 on the American side. sixteen digital elevation models covering the whole basin, seven on the Mexican side and 9 on the American side according to the official classification in both sides of the basin	**Federal, state and local agencies provide access to information at the national and/or local levels for this binational basin.**	**knowledge of stakeholder and agencies information needs is being accumulated**	**Basin-wide information system is created and being populated**

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include sixteen digital elevation models covering the whole basin, seven on the Mexican side and 9 on the American side according to the official classification in both sides of the basin				
Outcome II.2.1: Improve capability to manage critical water resources in the rio Bravo/Grande basin and in developing bi-national cooperation between Mexico and the United States, providing accurate and reliable data necessary for analysis and resolution of water resources issues.	**Water quantity, quality and groundwater data sources identified and data acquired for use in the integrated information system**	**Basin-level data available; basin-based data collection programs ongoing**	**Data needs are identified; data sources are identified**	**Data acquired in electronic format and "placed into" the integrated information system; standardized data collection and analysis protocols proposed**
Outcome II.2.2: Improve access to information of federal and state agencies in both sides of the rio Bravo/Grande basin.	**Integrated Information System is operational**	**Portal to access information created at the basin level, and supported by Mexico and the United States**	**Knowledge to exchange water information among agencies**	**Basin-wide information system is created and being populated**
Output II.2.1: A bilingual relational database (geodatabase) for the Rio Bravo/Grande basin including both water quantity and quality data, as well as groundwater information from both sides of this binational basin	**Completion and update of a bilingual binational geodatabase that includes water quantity, quality and groundwater information**	**Information in different formats available at the Basin level**	**Current datasets in both countries are considered in order to be part of this Integrated Information System**	**Integrated information system created**
Output II.2.2: WEB application for accessing the geodatabase and to show the results in a viewer implemented in Internet	Platform linking thematic databases, metadata catalogues, models and user interfaces within a WEB interface to offer a user friendly gateway for decision-makers, stakeholders, governments, private institutions and the public in general to access all available data and information of the Rio Bravo/Grande basin. This platform will work as a multiuser framework to allow the simultaneous access for the decision makers.	**Limited access to the basin information through Internet**	**information needs assessment initiated**	**Internet portal is created for accessing water information.**

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PART 3

PROJECT ANNEXES

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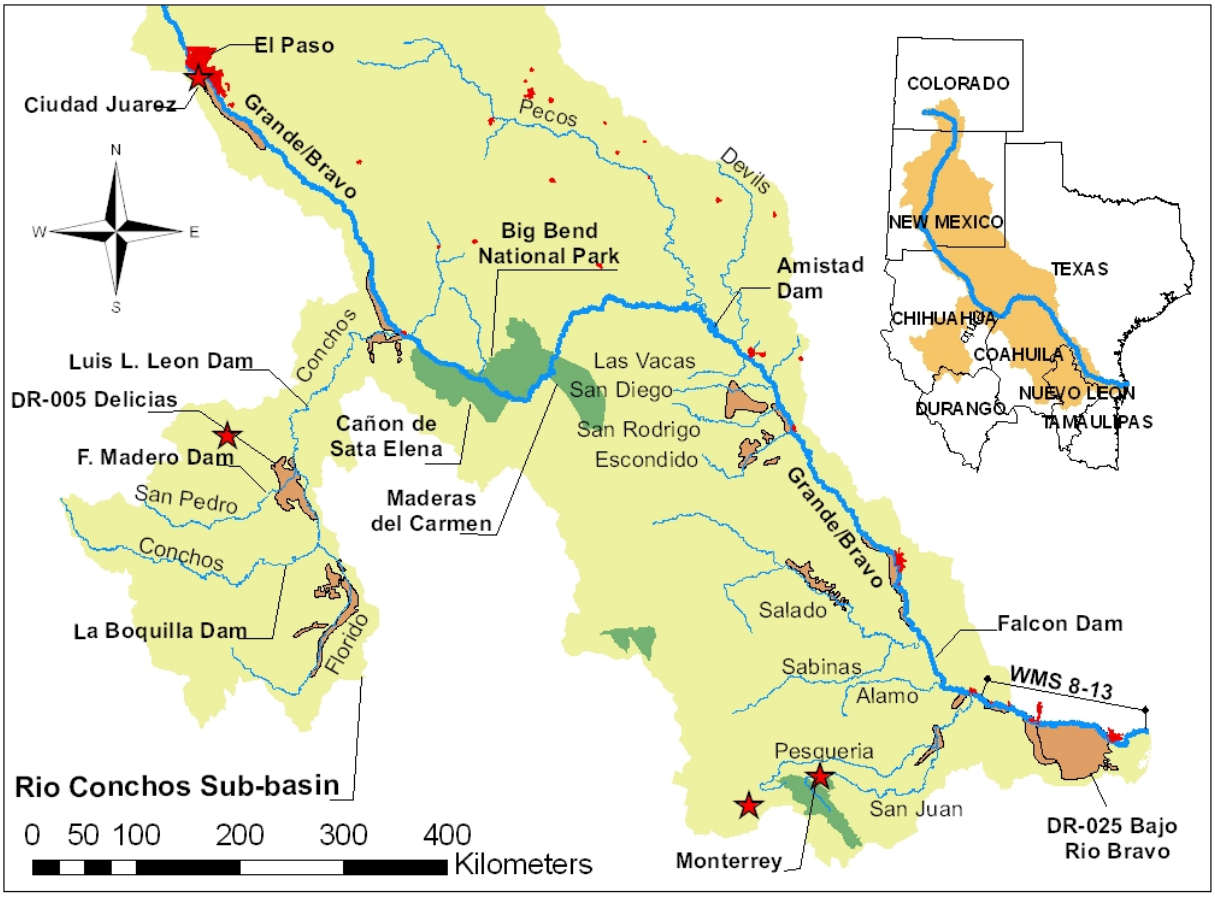
Annex 1. Location map



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ANEXO 2. Sub-project III.2 Non Structural Pilot Projects.

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PART 1

PROJECT IDENTIFIERS

Sub-project III.2

Non Structural Pilot Projects

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1.1 Sub-project title
Non Structural Pilot Projects

1.2 Link to umbrella project
Sub-project III.2 is linked to Activities I.1.2, II.1.3 and II.3.1.

1.3 Geographical scope
Rio Grande/Bravo River Basin (United States of America; Mexico)

1.4 Executing agency/entity
Specialized research institution or project execution team (to be identified and selected by a request for proposals), working in close coordination with the Project Coordination Unit (PCU) and in collaboration with National Project Units, under the oversight of the Implementing Agency (IA).

1.5 Duration
24 months

1.6 Focal areas
International Waters

1.7 GEF grant
US$ 1'000,000

1.8 Co-financing
US$ 313,875

1.9 Total funding
US$ 1,313,875

1.10 Associated financing
US$ XXX

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1.11 Contact person

1.12 Project summary

This sub-project is designed to increase awareness on how to diminish current and future water pressure in the rio Conchos basin, which is one of the most representative hydrological areas in the rio Bravo/Grande basin and that would be the case study area for implementing actions considered in the pilot projects. Proposed is to elaborate a blueprint program to prioritize actions towards reducing current water use through the modernization of irrigation techniques in the Delicias Irrigation District based on experiences and investments achieved by the Mexican National Water Commission (CONAGUA), the North American Development Bank (NADBANK), State Government of Chihuahua, among others, and the reduction of leaks in urban water distribution network of Chihuahua City. In order to discourage new water rights' requests it is envisaged to work on a draft agreement for intersectoral water transfers so that new needs of urban waters are met via fresh waters originally granted in concession to irrigation in exchange for urban treated wastewaters; this transfers, altogether with water use efficiency actions, will meet current and future water demands without increasing the water pressure in the rio Conchos basin, and, eventually, even decreasing it.

Another key objective of this sub-project is to assess different climatic variability and climatic change scenarios for the rio Conchos basin in order to identify the water rights that need to be restricted during drought periods and the ones that require to be decreased in the future due to climate change impacts; in these cases, it would be also required to link the economical or social activities affected with mitigation measures to cope with droughts and adaptation measures related to climate change to compensate their associated water use rights, such as the water use efficiency support addressed in the first activity of this sub-project. The climatic change scenarios will also be useful to identify the water rights that should be subject to greater physical efficiency so that the same products and services are still attained with a smaller water volume.

It is important to mention that Mexican Government, trough CONAGUA, Secretary of Environment and Natural Resources of Mexico (SEMARNAT), and the Secretary of Agriculture, Cattle Raising, Rural Development, Fishing and Nourishment (SAGARPA) recognize the importance and impact of the actions considered in the pilot projects, and hence they would replicate the actions in the pilot projects for the whole basin.

Activity	Output	Outcome
3. Water use efficiency in the rio Conchos basin	Blueprint program to prioritize i) the modernization of irrigation techniques in the Delicias Irrigation	Increased awareness on how to decrease the current water pressure in the rio Conchos basin due to over concession

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	District and ii) the reduction of leaks in urban water distribution network at the Chihuahua City. Both sites are located in the rio Conchos basin, which is one of the most representative watershed of the rio Bravo/Grande basin.	and assignment during drought periods
4. Intersectoral water transfers between the Delicias Irrigation District and the Chihuahua City	Draft on agreements to exchange fresh waters originally granted in concessions to irrigation for urban treated wastewaters, considering the Delicias Irrigation District and the Chihuahua city as the case study area for this project.	Enhanced awareness on how to reduce current and future urban water demand due to population growth and increased economical activities
5. Climate variability and climate change scenarios of 50 x 50 km for the rio Conchos basin	Drought Preparedness Methodology to identify the water use rights that require to be i) restricted during drought periods, and Assessment document of water use rights that may require to be ii) reduced in the future or iii) subject to greater physical efficiency because of climate change impacts. This methodology will include the downscaling process to generate climate change scenarios of 50 x 50 Km for the rio Conchos basin, that would represent results with much better resolution than the climate scenarios published by the IPCC (250 km X 250km)	Preparedness to face future water pressure due to natural climatic variability and foreseeable impacts of climate change in the rio Conchos basin

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Activity	Sources of funding				Total Cost (US$)
	GEF Funding (US$)		Co-financing (US$)		
3. Water use efficiency in the rio Conchos basin	$350,000	26.64%	$	%	$350,000
4. Intersectoral water transfers between the Delicias Irrigation District and the Chihuahua City	$350,000	26.64%	$313,875	23.89%	$663,875
5. Climate variability and climate change scenarios of 50 x 50 km for the rio Conchos basin	$300,000	22.83%			$300,000
TOTAL	$1,000,000	76.11%	$313,875	23.89%	**$1,313,875**

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PART 2

PROJECT DESIGN

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2.1 Background and context

The current population in the Mexican part of the Bravo River basin is 10'703,805 inhabitants, and the [Mexican] National Council of Population (CONAPO) estimates that in the year 2030 its population would be 13'252,000 inhabitants, an increase of 23.79%, most of them living in urban centers; CONAPO does not has as yet a prediction for the year 2050 but the *2006 UN Population Prospects*[3] indicates, in its medium variant, an overall Mexican population of 132'278,000 inhabitants for 2050, an increase of 24.16% with respect to current population, which represents an upper bound consistent with CONAPO's predictions.

According to the 2008 edition of the *Water Statistics in Mexico*[4], published annually by the [Mexican] National Water Commission (CONAGUA), the mean natural availability of water resources in the Mexican part of the Bravo River basin is 12,024 Mm^3/yr, from which 6,857 Mm^3/yr correspond to streamflows and 5,167 Mm^3/yr to aquifer's recharge. The water rights granted in concession to all uses is 9,191.3 Mm^3/yr, a value that renders a water pressure of 76.44%, a strong one. Consumptive water concessions from surface waters amount to 4,822 Mm^3/yr, a relative water pressure of 70.32%; the water concessions from groundwater are 4,368 Mm^3/yr, which corresponds to a relative water pressure of 84.54%. The bulkiest user of consumptive water is irrigation, which accounts for 4,163 Mm^3/yr of the surface water concessions and 3,277 Mm^3/yr of the groundwater concessions; the second bulkiest user of consumptive water is municipal uses, with 548 Mm^3/yr of surface water assignments and 631 Mm^3/yr of groundwater assignments.

Therefore the primary objective of this sub-project is to identify the needed policies to meet sustainably current water use rights and unsatisfied demands, and those envisaged for the year 2050 and beyond. Clearly needed is a more efficient water use throughout the basin: it is required to reduce water use through modernization of irrigation practices and reduction of leaks in urban water distribution network, considering the Delicias irrigation district and the Chihuahua City as the case study area. The intersectoral exchange of fresh waters originally granted in concession to Delicias irrigation district for urban treated wastewaters is a way to diminish new requests for water rights due to population growth, without increasing current water rights; these agreements between cities and irrigation districts require city financing on irrigation modernization in order for this use to release the water volumes needed by municipal uses. Last but not least it is also mandatory to establish restrictions to already granted concessions and assignments during droughts, and prevent possible reductions in the natural availability of water resources due to the impacts of climate change in the rio Conchos basin, where both Delicias irrigation district and the Chihuahua City are located, and, of course, identify adaptation measures.

The biodiversity of the rio Conchos basin has to be considered also. The basin

[3] United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2006 Revision, Highlights*, Working Paper No. ESA/P/WP.202, 2007.

[4] [Mexican] National Water Commission, *Water Statistics in Mexico, 2008 Edition*, Mexico City, Mexico, 2008, 228 pp. (In Spanish).

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supports many threatened and endangered species: water development projects have seriously disrupted natural flow regimes, affected wetlands and aquatic fauna, and degraded native riparian plant communities. Although part of the solution lies in better coordination of institutional activities on both sides of the border, this goal remains difficult and elusive. Also the lack of effective communication between water-user communities and other stakeholder groups constrain the sustainable use of the river's waters.

The mutual lack of knowledge in both sides of the border in regard to the other country's water information, water rights, juristic ordering, institutional coordination, social behavior, cultural conditioning and willingness to jointly address common problems and exclusive problems that affect the other riparian country, requires better ways to share information and ponder over possible alternatives to reach a sustainable solution. In this respect, it would be advisable to establish a permanent bi-national group of experts that gather, review, propose, evaluate and prioritize structural and non structural actions.

2.2 Sub-project objective

The overall objective of this sub-project is to formulate for the rio Conchos basin, which is one of the most representative watershed of the rio Bravo/Grande basin, i) a blueprint program to prioritize a) the modernization of irrigation techniques in the Delicias irrigation district and b) the reduction of leaks in urban water distribution network, considering the Chihuahua City as the case study area, ii) a draft on agreements to exchange fresh waters originally granted in concessions to irrigation for urban treated wastewaters, considering the Delicias irrigation district and the Chihuahua city as the case study area iii) a drought preparedness study to identify the water use rights that require to be restricted due to natural climatic variability during drought periods in the rio Conchos basin, and iv) an assessment document to quantify the amount of water use rights that may be needed to a) reduce in the future or b) subject to greater physical efficiency due to climatic change impacts in order to maintain or reach a sustainable use of the rio Conchos waters, generating climate change scenarios with a resolution of 50 km X 50 km that represent a better resolution than the climate scenarios published for Mexico by the IPCC. This action would be replicated for the whole rio Bravo/Grande basin on the Mexican side.

2.3 Environmental benefits

The activities considered in this sub-project are aimed at decreasing the water pressure on the basin. Those actions could be furthered to take into account not only human dimension problems but also terrestrial and aquatic ecosystems. While it is difficult to try to define an environmental discharge in a semi-deserted zone, which is under a severe water pressure with glints of over concession during drought periods, there is evidence that certain riparian ecosystems have been adversely affected by the diminishing of base flow. Hence the increase of base flow in the dry season, at least in endangered ecosystems, will result in an environmental benefit.

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2.4 Overall sub-project outcomes

The outcomes for the rio Conchos basin, which is one of the most representative hydrological areas in the rio Bravo/Grande basin, will be i) Increased awareness on how to decrease the current water pressure in the rio Conchos basin due to over concession and assignment during drought periods ii) enhanced awareness on how to reduce current and future urban water demand due to population growth and increased economical activities, and iii) preparedness to face future water pressure due to recurrent drought periods and foreseeable impacts of climate change in the rio Conchos basin.

2.5 Consistency of the sub-project with national/regional priorities and plans

Many regional and national priorities and plans that focus on the rio Conchos – rio Bravo basin are encompassed within ongoing activities of the two riparian countries, and which are consistent with the goals of this sub-project, as follows:

Regional

A) International Boundary and Water Commission (IBWC; the Mexican section of IBWC is the Comisión Internacional de Límites y Aguas (CILA)): The IBWC is binational body responsible for applying the boundary and water treaties between Mexico and the USA, and settling any differences that may arise in their application. Its mission is to apply the rights and obligations assumed by Mexico and the United States under numerous boundary and water treaties and related agreements in a way that benefits the social and economic welfare of the peoples on both sides of the boundary and improves relations between the two countries, including such issues as boundary demarcation, national ownership of waters, sanitation, water quality, and flood control in the border region.

B) Border 2012 Program: The 1983 Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (La Paz Agreement) is the legal basis for this binational collaborative programme. With active participation of 10 Mexican and US border states, and US tribal governments, the US Environmental Protection Agency (EPA) and Mexico's Secretary of Environment and Natural Resources (SEMARNAT), in partnership with the US Department of Health and Human Services (HHS), the Mexican Secretary of Health (SS) and other federal agencies, the goal of the Border 2012 Program is to improve the environment, and protect the health of people living along the common border, consistent with principles of sustainable development. The program focuses on providing safe drinking water, cleaning the air, reducing risks of exposure to hazardous waste, and ensuring emergency preparedness along the border region.

C) Border Environment Cooperation Commission (BECC): The BECC is a binational organization created by the Mexican and US Governments under a side agreement to the North American Free Trade Agreement (NAFTA). BECC's mission is to help conserve, protect and enhance the environment in the Mexico-US border

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region, through developing and certifying environmental infrastructure projects incorporating innovative sustainability and public participation concepts. BECC's mandate addresses water pollution, wastewater treatment, and municipal solid waste management projects, including issues such as hazardous waste, water conservation, water and sewer system hookups, and waste reduction and recycling. Air quality, transportation, clean and efficient energy, and municipal planning and development projects (including water management) have subsequently been added to BECC's mandate.

D) North American Development Bank (NADBank): The NADBank is a binational organization created by the Mexican and US Governments under another side agreement to the North American Free Trade Agreement (NAFTA). The NADBank is a binational financial institution capitalized and governed equally by the United States and Mexico for the purpose of financing environmental projects certified by the Border Environment Cooperation Commission (BECC). The two institutions work together with communities and project sponsors in both countries to develop and finance infrastructure necessary for a clean and healthy environment for border residents.

National

Mexico:

A) Secretary of Agriculture, Cattle Raising, Rural Development, Fishing and Nourishment (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, SAGARPA): In 2003 SAGARPA launched the *Water Rights Adjustment Program* (WRAP)[5] (Programa de Adecuación de Derechos de Uso del Agua, PADUA, for its Spanish acronym) in order to reverse the detrimental effects of over concession and over exploitation of water resources. The objective of PADUA is to promote the sustainability of irrigation systems as well as river basins and aquifers. The main thrust of PADUA is to recover water use rights in exchange for direct financial support in order to modernize irrigation techniques or simply recall water use rights from idle lands, precisely what Activity III.2.1 proposes to focalize in the Bravo River basin.

B) National Water Commission (Comisión Nacional del Agua, CONAGUA): CONAGUA is the only Mexican authority empowered to manage and preserve the national waters (when they are in its physical environment), with participation of society, in order to achieve the sustainable use of water resources. This includes the granting of water use rights, the regulation of uses and users and fiscal attributions to

[5] Asad, M. and H. Garduño, *Water Resources Management in Mexico: The Role of the Water Rights Adjustment Program (WRAP) in Water Sustainability and Rural Development*, World Bank, Washington, D. C., 2005, 73 pp.

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charge for water abstraction. CONAGUA has, among many others, the Program *Sustainable Use of Water in the Bravo River Basin* (Programa Uso Sustentable del Agua en la Cuenca del Río Bravo[6]), whose main objective is to attain the water sustainability through modernization of hydro-agricultural infrastructure and the introduction of more efficient techniques in lot irrigation. The program has been active since 2000 and is consistent with the proposed Activity III.2.2.

C) Secretary of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales, SEMARNAT): A ministry of the federal government, SEMARNAT is responsible for establishing the environmental protection policies to reverse ecological deterioration and promoting the basis for sustainable development in Mexico. A program directly related to Activity III.2.3 is the *Special Program on Climate Change* (Programa Especial de Cambio Climático[7]) whose main objective is to contribute to achieve the country's environmental sustainability through responsible participation in the care, protection, preservation and rational use of the natural resources in order to strengthen the economic and social development, without compromising the natural legacy and the life's quality of future generations.

United States:

A) U.S. Environmental Protection Agency (EPA): The EPA was established in 1970 as a federal response to growing public demands for cleaner water, air and land. The concerns of EPA's Region 6 encompass the US portion of the Rio Grande Basin, including facilitation of construction of wastewater and drinking water facilities for people living in unincorporated areas (colonias) along the US side of the border. The EPA also works with other federal, state and local agencies to help identify and solve border environmental problems.

B) Rio Grande Watershed Federal Coordinating Committee (RGWFCC): The RGWFCC is a consortium of 11 US federal agencies, including the US section of IBWC, National Park Service, EPA, Army Corps of Engineers, Bureau of Reclamataion, Department of Agriculture, Bureau of Indian Affairs, Bureau of Land Management, and National Weather Service. Its purpose is to facilitate familiarity of these agencies with each other's responsibilities and ongoing projects related to watershed planning activities relevant to the Mexico-US border, and facilitate opportunities for interagency collaboration.

[6] [Mexican] National Water Commission, *Program "Sustainable Water Use in the Bravo River Basin: White Book"*, Mexico City, Mexico, 2006, 76 pp. (In Spanish).

[7] Mexico. Federal Executive Power. *Special Program on Climate Change 2008-2012*, Mexico City, Mexico, 112 pp. (In Spanish).

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2.6 Consistency of the sub-project with the GEF strategies and its strategic programmes

This sub-project is consistent with long term Strategic Objective 2 of the IW GEF-4: to catalyze transboundary action addressing water concerns, and with Strategic Program 3: balancing overuse and conflicting uses of water resources in surface and groundwater basins that are transboundary in nature.

2.7 Coordination and linkages to the umbrella project activities and other related activities in the basin

The overall objective of the umbrella project is to create a framework for the sustainable management of the Rio Bravo/Grande basin waters. This includes the understanding of the basin's society and natural resources, in both sides of the border, on which to base the response strategies. The sub-project III.2, composed of non structural pilot projects, is part of those response strategies to be integrated, altogether with the structural pilot projects considered in sub-project III.1, into the Strategic Action Programme of sub-project III.4, which is the main output of the umbrella project.

2.8 Incremental reasoning

Baseline

Water apportionment in the Rio Grande River is set forth in the *Rio Grande Compact*[8], signed by New Mexico and Texas in 1938 and consented by US Congress in 1939, and the *Pecos River Compact*[9], signed by Colorado, New Mexico and Texas in 1948 and consented by US Congress in 1949. Water allotments to juristic persons is made by the Watermaster of each State, out of its water apportionment and the specific compact rules that take into account the annual variability of streamflows.

Apportionment between States in the Bravo River is not needed in Mexico since the property of water belongs, on a constitutional basis to the nation, represented for that purpose by the federal government, nowadays through the National Water Commission (CONAGUA, for its Spanish acronym). Water use rights for every use, in the whole country and not only in the Bravo River basin, are granted by CONAGUA. The water use rights for every use, except for the municipal one, are called *concessions* and may be transmitted through market mechanisms; the water use rights for municipal use are called *assignments* and cannot be traded under any circumstance.

[8] US Congress, Act of May 31, 1939, ch. 155, 53 Stat 785
[9] US Congress, Act of June 9, 1949, ch. 184, 63 Stat 159

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The 1944 *Treaty to Fix and Delimit the Rights of the Two Countries with Respect to the Waters of the Colorado and Tijuana Rivers, and of the Rio Grande (Rio Bravo) from Fort Quitman, Texas, United States of America, to the Gulf of Mexico*, states that the United States has the right to receive one third of the water volumes that reach the main stream of the Rio Grande/Bravo River that flow from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Creek (Arroyo) plus half the unmeasured tributaries not otherwise allotted. This part of the Treaty has always been met in the own terms of the Treaty, except until the cycle 27, running from September 31, 2002 till September 31, 2007, where there was accumulated 10 consecutive years without delivering the warranty of the minimum volume: 4,317.21 Mm^3. Fortunately, the amount of water not honored, 297.5 Mm^3, was delivered by Mexico during the month of October, 2007. Nevertheless, this fact caused several tensions between both countries since 2002, including differences in units (million acre-feet for the United States and million cubic meters for Mexico, as recognized by one of the former US ambassadors in Mexico[10], who was helpless witness of the incident), lack of knowledge about the terms in which the Treaty was negotiated (as the Vienna Convention requires for interpretation), and the historical functioning of the Treaty (in the first cycles there were uncompleted all the planned irrigation zones in Mexico and the third part of the streamflow in measured tributaries used to be much higher than the warranty: 2,158.605 Mm^3 every five consecutive years, unless the capacity of the bi-national reservoirs fill with water of US property, condition under which a new cycle begins).

All these situations have lead to a global water pressure of 76.44% in the Bravo River basin: a surface water pressure of 70.32% and groundwater pressure of 85.54%. With a prediction of population increase around 25% to the year 2050, inhabiting most of them in urban centers, and with an expected contribution of 17% to global Gross Domestic Product (GDP) but 35% expected contribution to GDP in the manufacturing sector, deemed highly water- consuming, the inertial scenario for the Bravo River basin is to increase the water pressure and the water stress, getting away from a sustainable condition.

Increment

It is clear that the “business as usual” scenario is unsustainable for the Bravo River basin, and particularly stressing for meeting the ever increasing water demands. Therefore, plausible actions in the future include more efficient use of water from the physical standpoint: convey, distribute and apply agricultural irrigation water minimizing the infiltration and evaporation; detecting, repairing and minimizing the water leaks in urban distribution networks; reaching agreements between cities and farmers in order to exchange fresh waters originally granted in concession to irrigation for urban treated wastewaters. The Delicias irrigation district and Chihuahua city are proposed to be considered as the case study area. This exchange is most meaningful when the city has a groundwater assignment and the producers have surface concessions: the exchange decreases the contamination in the water body

[10] Davidow, J., *The Bear and the Porcupine: The U.S. and Mexico*, Markus Wiener Publishers, Princeton, NJ, 2004, 257 pp.

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that would otherwise receive the discharge, the aquifer is not over exploited, and both users obtain the amount of water they need. The naturally recurrent variability in climate leads to droughts that call for restrictions to existing water use rights and, the possible impacts that climate change may impinge on the Bravo River basin, and specifically in the rio Conchos basin should not be overlooked: even if the above mentioned measures are put in place, a decrease of 20 or 30% in the natural occurrence of water resources in the basin requires much more aggressive measures.

Alternative

An alternative would be to lean on market-driven mechanisms in order to reassign water to the most economically efficient uses, preventing the water pressure to rise but not coping with the consequences of climate change in the rio Conchos basin, then this alternative could be extended to the rest of the basin on the Mexican side. Even if this alternative were to be considered as viable, it would be highly recommended to establish a regulated water market to preclude social disruptions.

Incremental reasoning

Perhaps the better way to address the sustainable use of the rio Conchos waters is to proceed simultaneously in several fields. The water use efficiency approach takes into account current water pressure; the intersectoral water transfer policy pays attention to current unsatisfied water demands and foresees the future ones; and, the climatic variability and climatic change scenarios look after the water over pressure that may be imposed to the basin due to local droughts and global conditions. It might be also useful to peruse the incremental benefits of using water banks and water markets in selected places of the basin and under controlled situations.

2.9 Activities, outputs, outcomes

Activity III.2.1 Water use efficiency in the rio Conchos basin

Objective: Keep obtaining the same agricultural production with less water, and keep delivering the public service of drinking water with less water amount.

Activities: i) Identification of irrigation areas that could be subject to the SAGARPA's PADUA program in order to decrease the water volume granted in concession in the rio Conchos basin, ii) identification of irrigation areas that could be benefited with the CONAGUA's program *Sustainable Water Use in the Bravo River Basin*, iii) catalogue of modernization actions to reduce infiltration in the conveyance, distribution and

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application of irrigation water, as well as in water leaks in urban distribution network in the Chihuahua city, iv) blueprint elaboration.

Outputs: A blueprint program to prioritize i) the modernization of conveyance and distribution of irrigation water and lot irrigation techniques in the Delicias irrigation district, and ii) the reduction of leaks in urban water distribution network considerin the Chihuahua City as the case study area.

Outcome: Increased awareness on how to decrease the current water pressure in the rio Conchos basin due to over concession and assignment during drought periods.

Funding summary:

Total Cost USD $350,000 – GEF Grant USD $350,000 – Co-financing

Activity III.2.2 Intersectoral water transfers between the Delicias Irrigation District and the Chihuahua City

Objective: Diminish the request of new water concessions and assignments through the City of Chihuahua and farmers collaboration agreements.

Activities: i) Evaluate the Delicias irrigation district and the City of Chihuahua as the case study area that could be encouraged to collaborate in order to exchange waters.

Outputs: An agreements' draft to exchange fresh waters originally granted in concessions to irrigation for urban treated wastewaters.

Outcome: Enhanced awareness on how to reduce current and future urban water demand due to population growth and increased economical activities.

Funding summary:
Total Cost USD $350,000 – GEF Grant USD $350,000 – Co-financing USD 313,875

Activity III.2.3 Climate variability and climate change scenarios of 50 x 50 km for the rio Conchos basin

Objective: Identify mitigation measures due to natural climate variability expressed in recurrent drought periods, and adaptation measures in order to reduce the impact of possible climate change effects on the occurrence of water resources in the rio Conchos basin, which is one of the most representative hydrological areas in the rio Bravo/Grande basin

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Activities: i) Ensemble research findings to select the best mitigation and adaptation measures before climate variability during drought periods and in face of climate change effects on the rio Conchos basin.

Output: Drought Preparedness Methodology to identify the water use rights that require to be i) restricted during drought periods, and Assessment document of water use rights that may require to be ii) reduced in the future or iii) subject to greater physical efficiency because of climate change impacts. This methodology will include the downscaling process to generate climate change scenarios of 50 x 50 Km for the rio Conchos basin, that would represent results with much better resolution than the climate scenarios published by the IPCC (250 km X 250km)

Outcome: Preparedness to face future water pressure due to recurrent climate variability expressed in droughts and to foreseeable impacts of climate change in the rio Conchos basin.

Funding summary:

Total Cost USD $300,000 – GEF Grant USD $300,000 – Co-financing USD

Sub-project objective and outcomes	Description of indicator	Baseline level	Mid-term target	End-of-project target
Objective Key actions for diminishing the water pressure in the rio Conchos basin are identified and prioritized	Modernization blueprint, agreement draft, drought preparedness methodology [11], and climate change assessment document done	SAGARPA's PADUA program, CONAGUA's program *Sustainable Use of Water in the Bravo River Basin*, and SHCP document The Economy of Climate Change in Mexico	Knowledge to decrease water pressure is available to key stakeholders	Authorities adopt the blueprint, draft agreement, drought preparedness study, and the assessment document as a policy

[11] A baseline for drought preparedness studies is the doctoral dissertation *Drought Preparedness Study in an Irrigation District*, by I. Velasco, National Autonomous University of Mexico, Mexico City, Mexico, 153 pp. + *xiii*. One Annex of 43 pp., May, 2002. (In Spanish).

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Sub-project objective and outcomes	Description of indicator	Baseline level	Mid-term target	End-of-project target
Outcome 1: Increased awareness on how to decrease the current water pressure in the rio Conchos basin due to almost over concession and assignment during drought periods	Percentage points of decrease in rio Conchos basin´s water pressure that affects directly to water pressure in the whole rio Bravo basin	Current water pressure is 76.44% and water stress 1,124 m^3/person/yr	Knowledge to modernize irrigation techniques is presented to key stakeholders	Authorities adopt a policy to reduce the water pressure to less than or equal to 70% through irrigation modernization
Outcome 2: Enhanced awareness on how to reduce current and future urban water demand of the City of Chihuahua due to population growth and increased economical activities	Percentage points of decrease in assignments ' requests for projected urban water demands	The 25% population growth rate to the year 2050 will require an additional water volume of 150 Mm^3	Knowledge to exchange waters is presented to key stakeholders	Authorities adopt a policy to reduce assignments' requests for projected urban water demands through intersectoral water transfers

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Sub-project objective and outcomes	Description of indicator	Baseline level	Mid-term target	End-of-project target
Outcome 3: Preparedness to face future water pressure due to recurrent climate variability expressed in droughts and to foreseeable impacts of climate change in the rio Conchos basin	Percentage points of water use rights' restrictions due drought conditions, and percentage points of decrease in water use rights' requests due to climate change impacts in the rio Conchos basin	Droughts are recurrent and they have variable intensity and severity. The vulnerability of the rio Conchos basin to climate change might decrease the water runoff in about 25%, according to IPCC's scenario A1[12] (1% per annum increase in effective carbon dioxide concentration in the atmosphere)	Knowledge to mitigate the effects of a drought and to adapt before the impacts of climate change is presented to key stakeholders	Authorities adopt a public policy to restrict water use rights during drought periods, and to reduce assignments' requests through adaptation measures due to climate change impacts

Project Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Output 1: *Blueprint program to prioritize i) the modernization of irrigation techniques in the Delicias Irrigation District and ii) the reduction of leaks in urban water distribution network at the Chihuahua City.*	Completion of blueprint	Techniques exist but they have not been encouraged enough	Modernization techniques are presented to stakeholders	Blueprint published

[12] Intergovernmental Panel on Climate Change, *Climate Change 2001: Impacts, Adaptation, and Vulnerability: Summary for Policy Makers*, Genève, Switzerland, 2001, 18 pp.

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Project Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Both sites are located in the rio Conchos basin, which is one of the most representative watershed of the rio Bravo/Grande basin.				
Output 2: *Draft on agreements to exchange fresh waters originally granted in concessions to irrigation for urban treated wastewaters, considering the Delicias Irrigation District and the Chihuahua city as the case study area for this project.*	Completion of agreements' draft	Only a few formal and informal cases are available	Intersectoral water transfers are presented to stakeholders	Agreement's draft published
Output 3: *Drought Preparedness Study to identify the restrictions in existing water use rights for diverse drought intensity and severity*	Completion of drought preparedness study	There are studies for irrigation districts, but not for the whole basin	Drought Preparedness Study is presented to stakeholders	Drought Preparedness Study published
Output 4: *Assessment of water use rights that may require to be i) reduced in the future or ii) subject to greater physical efficiency*	Completion of assessment	There are global and focalized studies over the Bravo River basin	Impacts of climate change are presented to stakeholders	Assessment published

2.10 Budget

Co-financing

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Sources of Co-financing	Type of Co-financing	Amount
Project Government Contribution	In-kind	
Bilateral Aid Agency(ies)	(select)	
Multilateral Agency(ies)	(select)	
Private Sector	(select)	
NGO	(select)	
Others	In-kind	
Total co-financing		

Project management budget

Cost Items	Total Estimated person weeks	GEF ($)	Other sources ($)	Project total ($)
Local consultants - *provide unit costs*				
International consultants – *provide unit costs*				
Office facilities, equipment, vehicles and communications – *please specify and provide cost breakdown and unit costs*				
Travel – please provide breakdown and unit cost				
Total				

Consultants working for technical assistance components:

Component	Estimated person weeks	GEF($)	Other sources ($)	Project total ($)
Local consultants - *provide unit costs*				
International				

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consultants - *provide unit costs*				
Total				

Consultants to be hired for the project

Position Titles	***$/ person week***	***Estimated person weeks***	***Tasks to be performed***
For Project Management			
Local			
International			
For Technical Assistance			
Local			
International			

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2.11 Timetable

Sub-project III.2 Non Structural Pilot Projects	YEAR 01				YEAR 02				YEAR 03				YEAR 04			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Activity III.2.1 Water use efficiency blueprint																
Activity III.2.2 Agreements' draft																
Activity III.2.3 Climate variability and climate change scenarios																
Publishing and dissemination of results																
Reports to the PCU																

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2.12 Cost-effectiveness

The reduction of water pressure in the rio Conchos basin through the proposed pilot projects —which include the diminishing of water use rights through PADUAS' program, modernization of conveyance, distribution and irrigation techniques, reduction of leaks in urban water distribution networks, intersectoral water transfers, a drought preparedness study, and climate change scenarios with their respective mitigation and adaptation measures— is much more cost-effective than trying to further develop water resources projects to meet increasing drinking water demands while honoring existing beneficial uses in another water-consumptive economical sectors, mainly irrigation.

From another viewpoint, to consider water transfers from another watershed is for all practical purposes out of the question. Increasing water demands elsewhere, the adverse environmental impacts and the high costs of transfers channels or aqueducts preclude nowadays to conceive an inter basin water transfer.

In Mexico there are no junior nor senior water rights holders, even though the municipal water uses have priority in new water allocations, but not in the annual basis distribution of water to meet existing water rights; therefore, all water use right's holders have the same right to an apportionment of water each year, even during drought periods.

2.13 Risk analysis

Risk	Rating	Risk mitigation measures
Efficient water use components (PADUA's program, irrigation modernization, and reduction of water leaks) are insufficient to reduce the water pressure	Low	Water concessions for irrigation in the Bravo River basin amount to 7,440 Mm^3/yr, which are used in 447,141 ha. The hydro-agricultural infrastructure includes 7,602 km of channels: 760 km of main channels, 152 km of which are unlined; 2,281 km of distribution channels, 1,521 km of which are unlined, and 4,561 km of application channels, 3,649 km of which are unlined. According to CONAGUA's program *Sustainable Water Use in the Bravo River Basin*, in a main channel can be saved about 3.44 Mm^3/km lining the channel; in a distribution channel can be saved 0.63 Mm^3/km lining the channel, and in application channels can be saved 0.24 Mm^3/km lining the channel. Therefore in the Bravo River basin can be saved around 523 Mm^3 lining main channels, 958 Mm^3 lining distribution channels, and 876 Mm^3 lining application channels, rendering a ceiling of 2,357 Mm^3 of

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		water saved in normal years by just lining channels (of course, during drought periods the saved water volume diminishes in proportion to the drought intensity). This quantity is more than enough to decrease the water pressure from 76.44% to around 60% on the average. Likewise, it is estimated that from PADUA's program in the Bravo River basin can be recovered around 500 Mm^3/yr, and from leaks' reduction in water distribution networks 390 Mm^3 in each normal year.
Reticence of farmers to engage on intersectoral water transfers	Low	The value of water to farmers is much more than the economic value from agricultural production; it comprises the whole chain of economic activity around agriculture, such as seeds, agrochemicals, labor, transportation, packaging, commercialization and the community's way of life. Besides that, most of the water rights holders in agriculture surpass the age of 65 years, which makes them much more cautious about diminishing their patrimony. The way to reduce this risk is to demonstrate to farmers, through pilot projects that the agricultural production output will remain unchanged and even increased with irrigation techniques modernization, which are the core of intersectoral water transfers: cities pay the irrigation modernization to obtain the released volumes from more efficient irrigation practices.
Drought severity cancels the provisions in the Drought Preparedness Study	Medium	The preventive measures in drought preparedness studies may raise the water security up to have full reservoirs. In the Bravo River basin the full reservoirs condition is, by itself, enough to satisfy only two consecutive years of the water rights granted, since the current water pressure is 76.44%. Therefore, even in mild intensity droughts of 15% deficiency in streamflows, a drought severity of 5 or more years, as is usual in the basin, may render the drought preparedness study measures useful in at most 4 consecutive years imposing restrictions to irrigation of about 75% and restrictions of 90% to municipal uses. Nevertheless, since the Bravo River basin's

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		reservoir capacity, 10,023.6 Mm^3, is hydrologically small (it stores less than the streamflow volume of a hydrologic year, which is 12,024 Mm^3) the usefulness of the drought preparedness study measures is constrained till up to 4 consecutive years, while drought periods usually last up to 7 consecutive years.
Climate change impacts surpass current predictions	Medium	The estimated 20% deficiency in streamflows in the Bravo River basin corresponds to the medium variant predictions of the IPCC. However, if the greenhouse-effect gases emissions continue to rise without significant reductions, the decrease in water resources in the basin might be deeper than considered. Under those circumstances further adaptation and remedial measures should be adopted, which will certainly require a wider effort in water use efficiency and modernization of water conveyance and distribution networks, as well as stringent constraints in water use.
Needed investments may be higher than the expenditure capacity	Medium	The average cost of modernization of irrigation techniques in surface water irrigated areas —the majority in the Bravo River basin— is US$3,280/ha, and US$3,766/ha in groundwater irrigated areas. From the 447,141 ha of irrigated lands in the Bravo River basin about 48% are irrigated with conventional gravity techniques; the average cost to modernize those areas is of the order of US$704 million. From another sector, the average cost to reduce leaks in water distribution networks and introduce better techniques in household water use is of the order of US$58/person; considering the whole population of 10'703,805 inhabitants in the basin it is estimated an expenditure of US$621 million. As for the PADUA's program, the World Bank estimates that in the Bravo River basin it would be needed US$47.5 million to recover 116.33 Mm^3 from groundwaters and US24.3 million to recover 309.5 Mm^3 from surface waters only in the Conchos River sub basin. Hence the minimum investment to decrease the water pressure in the Bravo River basin is of the order of US$1,400 million. Even

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		though this amount is manageable and there are Mexican NGO's supporting farmers to be more water-efficient and the NADBank may support cities within 300 km south of the border, needed are to upscale micro-financing institutions for farmers and dedicated funds for cities to adjust to the operation rules of the diverse federal programs.

2.14 Sustainability

The sustainable development in the rio Conchos basin for the 21st century has to take into account the current severe water pressure and the ways to address foreseeable population growth and economical activities that also demand water services. Therefore, it is unavoidable to consider a policy that discourages the opening of new areas to irrigated agriculture; on the contrary, it is needed to support and reinforce SAGARPA's *Water Rights Adjustment Program* to help decrease the water pressure. The PADUA's program has been operational since 2003 and it is not anticipated that it will conclude until a reasonable water pressure is achieved: one that will ensure that all water use rights and international commitments are honored, even during drought periods embedded in the impacts of climate change.

CONAGUA's program of *Sustainable Water Use in the Bravo River Basin*, operational since 2000, is aimed at decreasing the amount of water used in irrigated agriculture while preserving, or even increasing, the agricultural production. At present only the irrigation districts in the Conchos River sub basin have been active in the irrigation modernization efforts but it is required to expand the program to the states of Coahuila, Nuevo Leon and Tamaulipas to help decreasing the water pressure in the Bravo River basin. CONAGUA has another program, denominated *Drinking Water, Sewerage and Sanitation in Urban Zones* (APAZU, for its Spanish acronym, meaning Agua Potable, Alcantarillado y Saneamiento en Zonas Urbanas[13]) which addresses, among other issues, the reduction of leaks in urban water distribution systems.

As for the climate change mitigation and adaptation actions there is a [Mexican] *Inter Secretarial Commission on Climate Change*[14], where the ministries of agriculture, social development, communications, foreign affairs, energy, economy, and environment and natural resources come together to search for integrated responses. This permanent commission is in charge of coordinating, in the domain of

[13] [Mexican] National Water Commission, *Drinking Water, Sewerage and Sanitation in Urban Zones Program (APAZU): Consistency and Results Evaluation*, Mexico City, Mexico, 2008, 202 pp. (In Spanish).

[14] Inter Secretarial Commission on Climate Change, *National Strategy on Climate Change*, Mexico City, Mexico, 2007, 18 pp. (In Spanish).

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their respective competences, the actions of the entities of the federal public administration in relation to the formulation and implementation of national policies to prevent and mitigate the emissions of greenhouse effect gases, the adaptation to the impacts of climate change and, in general, to promote the development of programs and climatic action strategies related to the fulfillment of the international commitments signed by Mexico in the field.

Therefore there exists enough motivation and interest in Mexico to address the problem of the severe water pressure, not only in the Bravo River basin but in the semi-deserted and highly populated regions of the country, which explains the establishment of all those programs and inter secretarial commission long before the sought support from GEF and beyond.

2.15 Replicability

The proposed solution to search for sustainable use of water in the rio Conchos basin is based on nation-wide federal programs, as well as on ad hoc interventions which, notwithstanding, may be replicated in another severely water-stressed river sub-basins of the rio Bravo.

For the particular case of the rio Conchos basin, the up scaling strategy to spread out the outcomes of the pilot projects has to be rooted in an effective communication, outreaching and information program, as the one considered in sub-project III.3, to show farmers and cities how to make a more efficient water use from a physical and economical viewpoint. This should be encouraging enough for other producers and urban centers to seek sustainable solutions to provide the public water services.

Therefore the Strategic Action Programme (SAP), referred to in sub-project III.4, will include the upscale of the water use efficiency, intersectoral water transfers, drought preparedness study and climatic change scenarios components to as many farmers and cities as required to reach the final objective of maintaining or arriving at the sustainable water use in the Bravo River basin.

In fact, the policy making designed in Mexico to address the severe river basin's water pressure may be replicated elsewhere if an interested nation sets up similar policies. This is so because the main issue addressed in this sub-project is not how the near-over concession was attained but how to alleviate the severe water pressure and ensure that population growth demands in the light of future climatic change effects can be overcome.

2.16 Execution arrangement

The Project Coordination Unit will assure that the project's activities are executed according to the terms of reference in due time, under the oversight of the Executing Agency. The PCU will follow up the day-to-day activities' execution and implement eventual corrective actions through a quality assurance and quality control program. In order to make sure that the best and updated scientific knowledge is applied

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throughout the sub-project the PCU will corroborate that all activities contain appropriate terms of reference and that the proposed consultants are well qualified.

2.17 Public participation mechanisms

The increase in water use efficiency, the execution of intersectoral water transfers, the adoption of a drought preparedness study and further deepening these measures before climate change impacts require a communication program similar to the visioning process, Activity I.1.2, and the communications and dissemination strategy, considered in Activity III.3.1.

Farmers, municipal, state and federal authorities, as well as citizens, need to know what the natural availability of water resources is at present, what the implications for the future demand and consumption of water are in the light of population and economical activities growth, and what the alternatives are to face up the worsening of water pressure due to climate change impacts.

Therefore each activity of this sub-project will have a specific public participation component, including information dissemination, public consulting, stakeholder involving, wide collaboration to polish interventions, and empowerment of certain actions.

2.18 Monitoring and evaluation

A set of performance indicators will be used to measure inputs, activities, outputs, outcomes, and impacts of sub-project activities. The indicators will be used to set up performance targets and assessing progress toward their achievement, and to flag the need for a follow-up review or evaluation of an activity.

The monitoring and evaluation system will be used to measure the quantity, quality and targeting of sub-project outputs, and to measure the outcomes and impacts resulting from these outputs. The system is also expected to be a vehicle to facilitate the understanding of the causes for good and poor performance.

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Subproject III.2 Non Structural Pilot Projects	Indicator	Baseline level	Mid-term target	End-of-project target
Objective III.2 Key actions for diminishing the water pressure in the rio Conchos basin are identified and prioritized	Modernization blueprint, agreement draft, drought preparedness study, and climate change assessment document done	SAGARPA's PADUA program, CONAGUA's program *Sustainable Use of Water in the Bravo River Basin*, and SHCP document The Economy of Climate Change in Mexico	Knowledge to decrease water pressure is available to key stakeholders	Authorities adopt the blueprint, draft agreement, drought preparedness study, and the assessment document as a policy
Outcome III.2.1: Increased awareness on how to decrease the current water pressure in the rio Conchos basin due to over concession and assignment during drought periods	Percentage points of decrease in the rio Conchos basin's water pressure	Current water pressure is 76.44% and water stress 1,124 m^3/person/yr	Knowledge to modernize irrigation techniques is presented to key stakeholders	Authorities adopt a policy to reduce the water pressure to less than or equal to 70% through irrigation modernization
Outcome III.2.2: Enhanced awareness on how to reduce current and future urban water demand due to population growth and increased economical activities in the Chihuahua City	Percentage points of decrease in assignments' requests for projected urban water demands	The 25% population growth rate to the year 2050 will require an additional water volume of 150 Mm^3	Knowledge to exchange waters is presented to key stakeholders	Authorities adopt a policy to reduce assignments' requests for projected urban water demands through intersectoral water transfers
Outcome III.2.3: Preparedness to face future water pressure due to recurrent climate variability expressed in droughts and to foreseeable impacts of climate change in the rio Conchos basin	Percentage points of water use rights' restrictions due drought conditions, and percentage points of decrease in water use rights' requests due to climate change impacts	Droughts are recurrent and they have variable intensity and severity. The vulnerability of the Bravo River basin to climate change might decrease the water runoff in about 20%, according to IPCC's scenario A1 (1% per annum increase in effective carbon dioxide concentration in the atmosphere)	Knowledge to mitigate the effects of a drought and to adapt before the impacts of climate change is presented to key stakeholders	Authorities adopt a public policy to restrict water use rights during drought periods, and to reduce assignments' requests through adaptation measures due to climate change impacts
Output III.2.1: Blueprint program to prioritize i) the modernization of irrigation techniques in the Delicias irrigation District and ii) the reduction of leaks in urban water distribution network in the Chihuahua City	Completion of blueprint	Techniques exist but they have not been encouraged enough	Modernization techniques are presented to stakeholders	Blueprint published
Output III.2.2: Agreements' draft to exchange fresh waters originally granted in concessions to Delicias irrigation district for urban treated wastewaters	Completion of agreements' draft	Only a few formal and informal cases are available	Intersectoral water transfers are presented to stakeholders	Agreement's draft published
Output III.2.3: Drought Preparedness Study to identify the restrictions in existing water use rights for	Completion of drought preparedness study	There are studies for irrigation districts, but not for the whole basin	Drought Preparedness Study is presented to stakeholders	Drought Preparedness Study published

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diverse drought intensity and severity				
Output III.2.4: Assessment of water use rights that may require to be i) reduced in the future or ii) subject to greater physical efficiency	Completion of assessment	There are global and focalized studies over the Bravo River basin	Impacts of climate change are presented to stakeholders	Assessment published

2.19 Logframe

The logframe analysis, Annex 4, maps the causal links between sub-project activities and desired outcomes and impacts, although it is not designed to identify possible causal relationships between sub-project actions and subsequent improvements in performance. Any available data, including performance indicators, are analyzed to assess the efficiency and effectiveness of each activity.

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PART 3

PROJECT ANNEXES

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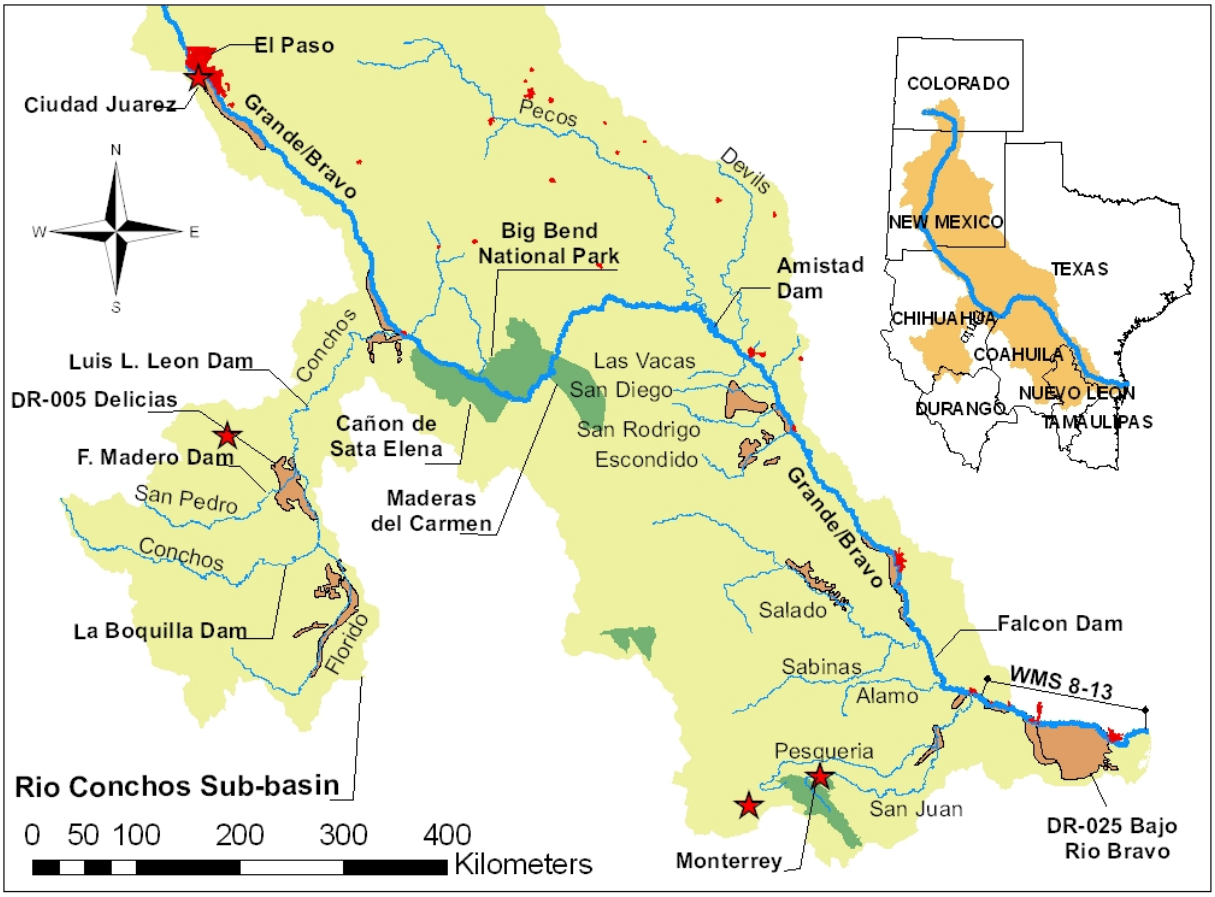
Annex 1. Location map



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Annex 2. Budget table

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Annex 3. Timetable

Sub-project III.2 Non Structural Pilot Projects	YEAR 01				YEAR 02				YEAR 03				YEAR 04			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Activity III.2.1 Water use efficiency blueprint																
Activity III.2.2 Agreements' draft																
Activity III.2.3 Climate variability and climate change scenarios in the rio Conchos basin																
Publishing and dissemination of results																
Reports to the PCU																

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Annex 4. Logframe

Objective hierarchy	Inputs, indicators and targets	Monitoring mechanisms and sources of information	Assumptions and risks
Sub-project III.2 Non Structural Pilot Projects			
Goal (long-term objective) The success in decreasing the water pressure is kept to the point that sustainable use of the rio Conchos basin waters is achieved.	Recovery of terrestrial and aquatic ecosystems is observable. Irrigation and cities have a high percentage of water use rights fulfillment. Droughts are managed without substantial damages. The impact of climate change in the river basin is successfully adapted to the water demands and hydrological conditions.	Besides making sure that the river basin has a water pressure below 50%, riparian ecosystems are recovered and base flows are able to nurture them.	The interest of the communities in the river basin assures that sustainable solutions will be sought. As for the authorities, it is clear their responsibility in planning for a long-term solution to the sustainable use of the transboundary waters of the Bravo River basin.
Purpose (immediate project objective) The water pressure on the rio Conchos basin, which is one of the most representative hydrological areas in the rio Bravo/Grande basin, starts to decline.	If the water pressure decreases from its current value of 76.44% the immediate objective of the sub-project has been attained.	The required information to assure that the water pressure has declined are the [Mexican] Public Registry of Water Use Rights (REPDA, for its Spanish acronym), the streamflows measured in river gauges, and the infiltration estimated to recharge aquifers.	Once the water pressure starts to decline it is expected that the authorities persevere in keeping the project's objective and expanding it as far as possible.
Outputs (results) A blueprint aimed to increase water use efficiency, a draft's agreement for intersectoral water transfers, a drought preparedness study, and an assessment document to address climate change impacts on water resources are completed.	The four documents are elaborated with the participation of water users, authorities, citizens and related stakeholders.	The necessary information will be gathered through scientific research, public evaluation of federal programs, and meetings with stakeholders and experts.	If the outputs consisting in documents with feasible proposals for Bravo River basin-ad hoc water resources policies are developed with the concourse of responsible authorities it is highly likely that they will propel them to be operational.
Activities (actions)	The knowledge to increase	The necessary information	If these activities are

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It will be gathered information about how to increase the physical efficiency in irrigation techniques and in decreasing leaks in urban water distribution networks. It will be designed a draft's agreement to execute intersectoral water transfers. It will also be developed the ad hoc drought preparedness study for the rio Conchos basin and the better ways to adapt to climate change scenarios.	water use efficiency is well known; however, the access to micro-financing for irrigation is essential to the success of this action. For cities there are well established financial mechanisms but require encouragement to city official who last only three years in office. The juristic order to draft an intersectoral agreement draft is well known, as is the set of actions to design a drought preparedness study. However, the input knowledge to adapt before climate change scenarios is still debatable.	to perform these actions is contained in books, journals, reports and public policies. Notwithstanding, expert consultations will be conducted.	executed with the participation of stakeholders and responsible authorities the outputs will be widely available to all interested parties in river basin.

Annex 5. International waters indicator matrix

Process outcomes and indicators

Process outcomes	Process indicators (report vs. baseline if possible)	
	Catalytic	Project
Stakeholder involvement in pilot projects	Knowledge base is available to stakeholders for them to use it in decision making processes.	Stakeholders' stances are based on bi-national information.

Stress reduction outcomes and indicators

Stress reduction outcomes	Stress reduction indicators (report vs. baseline if possible)	
Project element	Catalytic	Project
Pilot projects demonstrate stress reduction as measured by basin's water pressure	Stakeholders contribute to ease water pressure and increment agricultural production, as well as drinking	The policies based on the output's documents help authorities putting in the way toward sustainable water use

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	water coverage.	in the basin.

Environmental/water resources status outcomes and indicators

Environmental/water resources (& socioeconomic) status outcomes	Environmental/water resources (& socioeconomic) status indicators	
Project	**Catalytic**	**Project**
Riparian ecosystems start recovering.	The increase of base flow help improving water quality in the basin water bodies.	Active stakeholders in the sub-project's activities improve their quality of life due to enhanced livelihoods and production.

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Annex 6. Terms of reference for all consultants and personnel to be hired under this sub-project

Post: Research Scientist, for the UNEP/GEF Project "Regional Framework for the Management and Sustainable Use of the Bravo River Basin"

Functions:

Under the overall supervision of the Project Coordination Unit (PCU), the Research Scientist shall take overall responsibility for directing, managing and guiding the conduct of the Water Use Efficiency Activity (with similar TOR's for the remaining activities). More specifically the Research Scientist shall discharge the following functions:

1. Formulate and recommend policies and strategies to the PCU for the implementation of the project, in particular regarding:

   i) the establishment of the components of the Water Use Efficiency steering group;
   ii) the development of an overall management plan for the project.

2. Direct and supervise the implementation of the overall management plan for the Water Use Efficiency activity, by:

   i) liaison with the Head of the Integrated Water Management Department at the Mexican Institute of Water Technology on substantive matters, on a regular basis;
   ii) liaison with the authorities of the Mexican Institute of Water Technology regarding financial and administrative matters on a day-to-day basis;
   iii) liaison with the UNEP/GEF Co-ordination Office regarding matters of relevance to the Global Environment Facility;
   iv) reporting to and participating in, the meetings of the Water Use Efficiency steering group;
   v) participating in appropriate meetings of the regional and thematic task teams;
   vi) Managing the execution of the project on a day-to-day basis.

3. Formulation, completion and dissemination of the Water Use Efficiency activity, by:

   i) convening the necessary stakeholders consultations;

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ii) analyzing the experience of the regional water authorities in order to design a methodology for disseminating the existing programs to move toward a more efficient water use in the basin;
iii) designing guidelines for the conduct of micro-financial needs at sub-regional and regional scales;
iv) identifying the need for, and establishing appropriate Thematic Task Teams including a socio-economic task team;
v) developing approaches to the application of incremental cost analysis in International Waters projects;
vi) Developing draft methods and approaches to be used during the predictive and policy options analysis phases of the project.

2. Providing guidance to the work of the regional and thematic task teams, regarding:

i) socio-economic analyses and the disaggregation of existing data;
ii) methods and approaches to be used during the predictive and policy options analysis phase;
iii) the development and evaluation of scenarios based on current trends and projections and the outcome of alternative actions taken to address societal causes of identified water-related environmental issues and problems.

3. Supporting the work of the regional and thematic task teams, by:

i) convening and organizing as appropriate, meetings of the various task teams;
ii) providing specialist assistance and expertise as required, in the analysis of information gathered by national experts and institutions the provision of additional expertise to regions and the application of the agreed assessment protocols;
iii) Ensuring the transfer and sharing of experiences and information between the various regional and thematic task teams.

4. Managing UNEP's interactions with external entities including the media and potential additional donors and partners, regarding the Bravo River basin projects, in order to ensure responsiveness to governments, as well as to co-ordinate with the work of other international organizations, non-governmental organizations, scientific institutions, and the media, through:

i) participating in appropriate meetings of CONAGUA;
ii) participating in other relevant international meetings and secure extended participation and support for the project;
iii) organizing meetings with relevant stakeholders;
iv) liaison with potential donors, co-financiers and other potential contributors and participating in appropriate meetings of such bodies;

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