

# Border Environment Cooperation Commission Wastewater Treatment Plant Project for the City of Hermosillo, Sonora

## 1. General Criteria

### 1.a Project Type

**Project Name:** Wastewater Treatment Plant for the City of Hermosillo, Sonora.

**Project Sector:** Wastewater Treatment.

### 1.b Project Category

**Category:** Community Environmental Infrastructure Project – Community-wide impact.

### 1.c Project Location and Community Profile

**Community:** Hermosillo, Sonora

**Location:** The City of Hermosillo is located in the central part of the State of Sonora, 162 miles south of the U.S.-Mexico border.

**Location within the border:** The City of Hermosillo is located in the central part of the State of Sonora, 162 miles south of the U.S.-Mexico border.

**Figure:** Within the 300 km (186 mi) border area.



Figure 1. Location of Hermosillo in the State of Sonora

<b>Demographics</b>	
<b>Current population:</b>	785,082 residents
<b>Growth rate:</b>	2.22 %
Reference:	Based on data provided by Consejo Nacional de Poblacion (CONAPO).
<b>Prevailing economic activity:</b>	Service, Agriculture, Manufacturing Industry.
<b>Marginalization rate:</b>	-1.82 Very Low
<b>Services<sup>1</sup></b>	
<b>Community:</b>	Hermosillo, Sonora
<b>Water System</b>	
Water coverage:	98%
Domestic hookups:	238,228
Water supply source:	124 deep wells
<b>Wastewater Collection System</b>	
Wastewater coverage:	96.9%
Number of sewer connections:	232,738
<b>Wastewater Treatment</b>	
Wastewater treatment coverage:	11%
<b>Solid Waste</b>	
Waste collection coverage:	100%
<b>Street Paving</b>	
Street paving coverage:	72%
<b>1.d Legal Authority</b>	
<b>Project sponsor:</b>	<i>Agua de Hermosillo</i> (local Water Utility).
<b>Legal representative:</b>	Leovigildo Reyes Flores
<b>Legal instrument to demonstrate legal authority:</b>	Agreement of creation of the Utility, published in the State Government's Official Bulletin, Number 7, Section I on January 24, 2002, and related amendments published in the State Government's Official Bulletin, Volume CLXXVIII, Number 36, Section III on November 3, 2006.
<b>Date of instrument:</b>	January 24, 2002.
<b>Compliance with agreements:</b>	<ul style="list-style-type: none"> <li>• 1994 North American Free Trade Agreement (NAFTA)</li> <li>• 1990 Integrated Border Environmental Plan (IBEP)</li> <li>• 1983 La Paz Agreement, or Border Environment Agreement</li> </ul>

<sup>1</sup> Information updated on June 2010. Ayuntamiento de Hermosillo, *Agua de Hermosillo*

## 1.e. Project Summary

**Project description and scope:** Design, construction, and operation of a 57 MGD wastewater treatment plant for the city of Hermosillo, Sonora to provide 100% wastewater treatment coverage.

Additionally, the project proposes the expansion of the Wastewater Gravity Main with an additional 1.43 miles of a 96-inch diameter pipeline to convey wastewater to the proposed treatment facility. A pump station is also proposed to distribute reclaimed water to different reuse sites (agricultural usage, aquifer recharge, and urban uses).

### Components

#### Wastewater Collection

The project consists of:

#### **Wastewater Gravity Main**

Construction of a 96-inch diameter pipeline with 1.43 miles in length.

#### Wastewater Treatment

The project consists of:

#### **Hermosillo Wastewater Treatment Plant (WWTP)**

The proposed capacity for the wastewater treatment plant is 57 MGD. The facility will meet the requirements established by Mexican Standard NOM-003-SEMARNAT-1997 for public water use with direct human contact (BOD<sub>5</sub> 20 mg/liter/ TSS 20 mg/liter).

The proposed technology includes the following components: Pretreatment, Primary Treatment, Secondary Treatment, Disinfection, and Sludge Treatment.

Additionally, as an integral part of the wastewater treatment plant, the construction of two pump stations are also being proposed –one for raw wastewater and a second station for treated wastewater.

**Population served:**

785,082 residents

**Project cost:**

\$1,045 million Mexican pesos.

**Project map:**

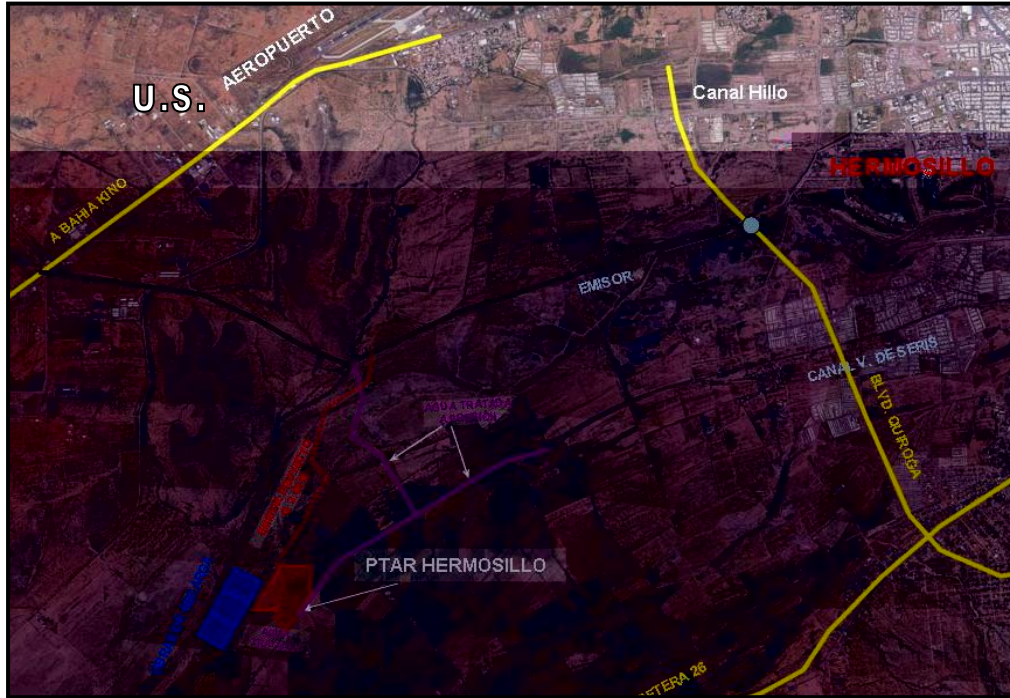


Figure 2. Layout of the Hermosillo WWTP and Gravity main.

## 1.f Project Justification

**Project justification:**

- At present time, 45.6 MGD of raw wastewater are discharged to streams west of the city, which eventually flow into the Sonora River, contaminating this body of water and creating a source of infection for local residents.
- The project will reduce the potential for groundwater contamination by improving the quality of the wastewater discharges and will provide reclaimed water for agricultural irrigation and other uses, reducing the demands on potential drinking water resources.
- The project will contribute to the reduction of water-borne disease associated with exposure to untreated wastewater.

**Urgency of the project or consequences of no action:**

- Untreated wastewater discharges jeopardize the health of the area residents and increase risks of contracting associated diseases.
- Contamination of ground and surface waters, resulting in health risks for the population in general.

**Pending Issues:**

None

**Criterion Summary:**

The project falls within BECC priority sectors and meets basic general criteria.

## 2. Human Health and Environment

### 2.a Compliance with Applicable Environmental Laws and Regulations.

**Environmental and human health conditions addressed by the proposed project:**

- Appropriate wastewater treatment. The construction of this treatment plant in Hermosillo will provide treatment to wastewater flows (45.6 MGD) that are being discharged without treatment to the Sonora River.
- Reduce the risk for communicable waterborne diseases caused by human contact with raw wastewater runoff resulting from the lack of treatment in Hermosillo.
- Reduce soil and surface water contamination, since it has been estimated that a portion of this raw wastewater is being used for agricultural irrigation.

**Human health**

As shown in the health statistics section below, there are a significant number of cases per year of waterborne diseases in Hermosillo, where the project is located. The statistics registered a number of cases of intestinal diseases, helminthiasis and amebiasis. It is expected that the project implementation will contribute to reduce the number of cases of these waterborne diseases.

**Environmental**

- Wastewater discharges in the project area, due to a lack of wastewater treatment, are a potential source of disease-causing organisms and soil, surface and groundwater contamination.
- The inappropriate disposal of untreated wastewater in the area of influence of the Hermosillo WWTP (Sonora River watershed), results in wastewater runoff in the Sonora River, where wastewater flows are intercepted during dry weather flows and conveyed to the Mar de Cortés for final discharge.

The environmental conditions addressed by the project are:

- Wastewater connections without treatment: 207,137
- Flow of uncollected wastewater discharges: 2,000 lps (45.6 MGD)
- Total estimated organic load (based on BOD<sub>5</sub>): 48.75 tons/day
- Estimated total suspended solids (TSS): 45.89 tons/day

The discharge of untreated wastewater in the aquatic environment can lead to the development of sludge deposits and anaerobic conditions due to its high content of suspended solids<sup>2</sup>. Total suspended solids are an important cause of water quality

<sup>2</sup> Metcalf & Eddy Inc, "Wastewater Engineering: Treatment, Disposal, Reuse", 3rd ed., McGraw Hill, New York, 1991.

deterioration leading to aesthetic issues, higher costs of water treatment, a decline in the fisheries resource, and serious ecological degradation of aquatic environments.<sup>3</sup>

Biodegradable organics are measured most commonly in terms of BOD<sub>5</sub> (biochemical oxygen demand). If these compounds are discharged into the environment without treatment, their biological stabilization can lead to the depletion of natural oxygen resources and to the development of septic conditions<sup>4</sup>. The higher the amount of BOD, the more water is polluted with organic waste; this often leads to algal bloom and eutrophication, which is more common in stagnant waters such as ponds and lakes. Algal bloom and eutrophication lead to the suffocation of fish and other organisms in a water body.

**The project meets the following applicable environmental laws and regulations:**

- The proposed wastewater treatment system will meet the requirements established by Official Mexican Standards NOM-001-SEMARNAT-1996, NOM-003-SEMARNAT-1997, and NOM-004-SEMARNAT-2002.
- The construction of the proposed civil works will follow the guidelines established by the National Water Commission (CONAGUA) for the construction of this type of infrastructure. Additionally, there is no expected impact to protected areas or ecological reserves, as construction will take place over previously impacted urban and rural areas.
- During the implementation of the project, *Agua de Hermosillo* and CONAGUA will oversee construction activities for conformance with the aforesaid CONAGUA guidelines.

## 2.b Human Health and Environmental Impacts.

### Human Health Impacts

**Direct and indirect benefits to human health:**

- Eliminate surface and groundwater contamination resulting from raw wastewater discharges.
- Reduced ground contamination
- Safer agricultural and cattle-raising practices.
- Elimination of infection sources.

<sup>3</sup> G.S Bilottal and R.E Brazier, "Understanding the influence of suspended solids on water quality and aquatic biota", Water Research, Volume 42, Issue 12, June 2008, Pages 2849-2861

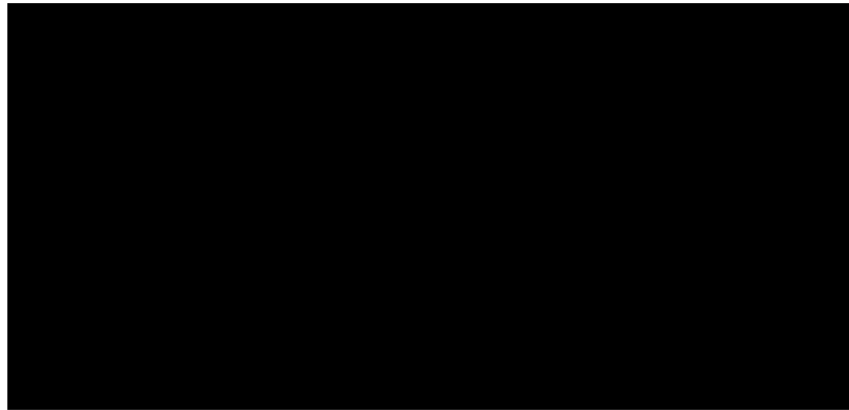
<sup>4</sup> Metcalf & Eddy Inc, "Wastewater Engineering: Treatment, Disposal, Reuse", 3rd ed., McGraw Hill, New York, 1991.

**Health statistics:**

Water borne diseases are caused by pathogenic microorganisms that are directly transmitted as a result of inadequate wastewater disposal practices and unhealthy water supplies. An individual may become ill after drinking water that has been contaminated with these organisms; eating uncooked foods that have been in contact with contaminated water; or having bad hygiene habits that contribute to the dissemination of diseases by direct or indirect human contact. Water borne diseases may be caused by protozoan, viruses, bacteria, and intestinal parasites.

**Supporting figures:**

Table 1. Gastrointestinal Diseases in Hermosillo, Sonora.



**Environmental Impacts**

**Environmental impacts:**

Minor environmental impacts are anticipated to occur during the development of the different project phases, as long as the project tasks are implemented following the specifications of the Environmental Impact Statement submitted to SEMARNAT, and taking into account the mitigation measures established in the document.

Potential impacts include the following:

**Site Preparation and Construction Phase**

- Removal of earth material and vegetation
- Fugitive dust emissions
- Gas emissions from construction machinery

**Operation and Maintenance Phase**

- Sludge generation
- Potential foul odors

**Mitigation measures:**

**Mitigation measures will include:**

- Replacing site vegetation.
- Applying water to reduce fugitive dust emissions.
- Tuning up vehicles to reduce emissions.



- Installing warning signage to prevent potentially hazardous situations.
- Ensuring an efficient WWTP operation to prevent foul odors, and implementing odor minimization systems.

**Impacts:**

The environmental impact resulting from the project's implementation will be positive overall, since:

- The project will improve the quality of the discharging water, and the reclaimed water to be used for agricultural irrigation.
- The project will provide treatment to 100% of Hermosillo's generated wastewater.
- Reclaimed water will be made available for other purposes such as aquifer recharge and city usages.
- The project will improve the quality of life of local residents by reducing potential health hazards.

**Transboundary Impacts**

No transboundary impacts are anticipated considering the geographic location of Hermosillo with respect to the U.S.-Mexico border.

**Formal Environmental Clearance**

**Environmental Clearance:**

Pursuant to the provisions set in the General Law on Ecological Balance and Environmental Protection regarding Environmental Impact Statements, Mexico's Secretariat of the Environmental and Natural Resources (SEMARNAT), through Official Communication No. DS-SG-UGA-IA-0354-09, established that, based on the Environmental Impact Statement submitted by *Agua de Hermosillo*, the project complies with all the requirements of the Mexican environmental clearance process.

**Results Measurement Project Matrix Summary**

**Results Measurement**

**Indicators and Targets**

**1. Provide Access to Wastewater Treatment**

Construction of a new wastewater treatment plant. (target = 2,500 lps [57.08 MGD])

**Baseline Value**

Existing for this service area<sup>5</sup>=361 lps (8.24 MGD)

<sup>5</sup> Current treatment capacity in the municipality of Hermosillo, Son. *Agua de Hermosillo*

<b>2. Reduction of untreated WW discharges to water bodies or other (protection of natural resources)</b>	<b>Indicators and Targets</b> Capacity to eliminate untreated wastewater discharges <sup>6</sup> (target= 2,000 lps (45.6 MGD))
	<b>Baseline value</b> Capacity: 0 MGD
<b>Outputs: Goods and services that the project will deliver</b>	Construction of the Hermosillo WWTP: 2,500 lps (57.08 MGD) Construction of a 96-inch diameter pipeline 1.43 miles in length.

**Pending Issues:**

None

**Criterion Summary:**

The project complies with BECC's Human Health and Environment criteria.

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<sup>6</sup> Information based on wastewater flow projects for 2010 in the influence areas of the treatment plant, *Agua de Hermosillo*.

## 3. Technical Feasibility

### 3.a Technical Aspects

#### Project Development Requirements

**Design criteria:**

The proposed Hermosillo WWTP will be located approximately 4.7 miles west of the city of Hermosillo, alongside the Hermosillo-Bahia de Kino highway.

Basic studies and supplementary works designs were based on technical specifications contained in the Water, Wastewater Collection and Treatment Manual prepared by CONAGUA.

No final design has been prepared for the Hermosillo WWTP. The construction of the proposed WWTP will be based on a Build-Operate-Transfer (BOT) scheme, under which the selected company will provide the following services:

- Verification of basic design data.
- Final Design.
- Construction.
- Electromechanical equipment.
- Start-up tests.
- Capacity tests.
- Operation, Conservation, and Maintenance.
- Removal, treatment and final disposal of biosolids and solids.

The project includes the following components:

**Expansion of the Wastewater Gravity Main**

1.43 miles of tight-sealed 96-inch diameter pipeline.

**Hermosillo WWTP**

Design, construction, and operation of a Wastewater Treatment Plant with a 57 MGD capacity, in modules of no less than 11.5 MGD that must contain the following components as a minimum:

**Wastewater Treatment**

- Rough screening unit
- Fine screening unit
- Grit and grease removal
- Raw wastewater lift station
- Primary sedimentation
- Secondary (biological) treatment
- Secondary sedimentation

- Disinfection unit
- Treated wastewater lift station

**Management of byproduct sludge**

- Sludge removal and storage system
- Biological sludge treatment
- Sludge dewatering
- Sludge thickening
- Final sludge disposal

**Appropriate Technology**

Wastewater treatment

The treatment technology for the Hermosillo WWTP will be Extended Aeration-Oxidation Ditch, complying with the guidelines as requested and listed in this section and the required water and sludge quality standards, which are consistent with Mexican Standards NOM-003-SEMARNAT-1997 and NOM-004-SEMARNAT-2002, respectively.

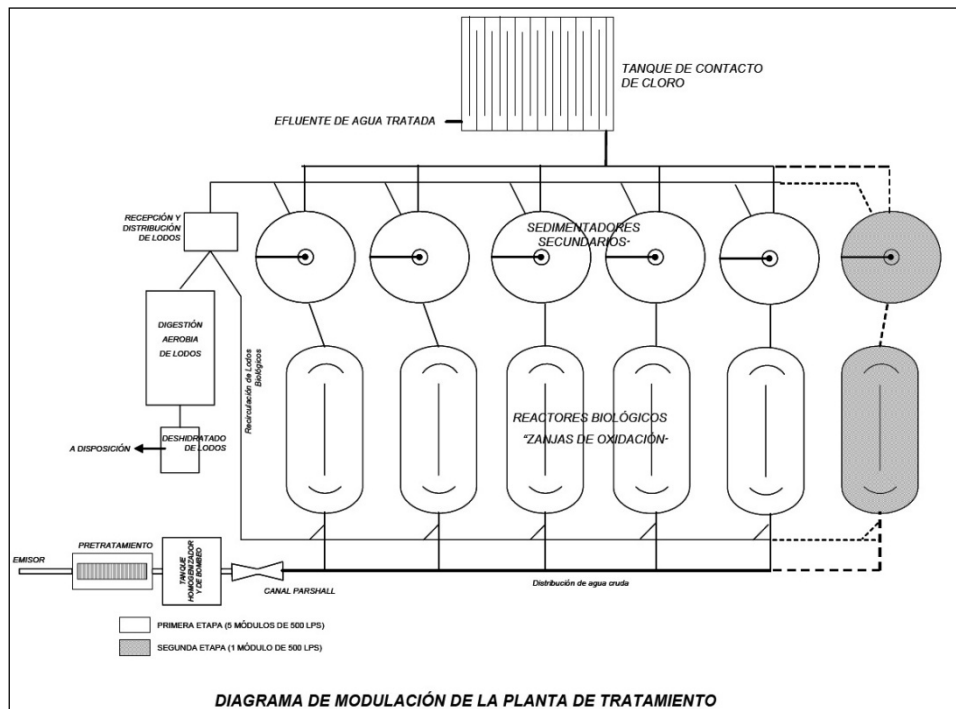


Figure 3. Possible Layout of the Hermosillo, Sonora Wastewater Treatment Plant

**Assessment of Alternatives:**

Wastewater treatment

For the preliminary analysis and evaluation of the proposed treatment technologies, consideration was given to those

technologies that ensured compliance with Standard NOM-003-SEMARNAT-1997 and those that were compact in size and had a proven success record in the country. Therefore, the treatment technologies assessed, based on the activated sludge process, included the following:

- Complete Mix Activated Sludge.
- Extended Aeration Activated Sludge.
- High-Rate Activated Sludge.
- Oxidation Ditch Activated Sludge.

The comparative assessment of the alternatives included an estimation of initial investment costs, as well as operation and maintenance costs for each technological alternative. Estimations also included the annual investment amortization rate at 12% for a 20-year term.

The four technological alternatives reviewed are capable of meeting the necessary quality requirements.

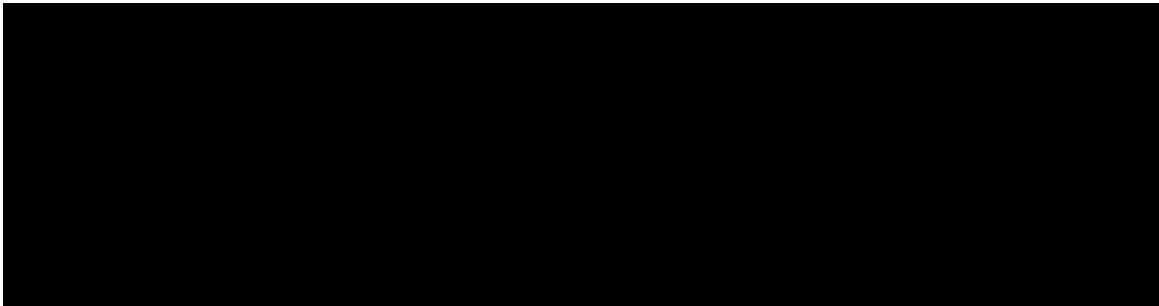
### **Property and Right-of-Way Requirements**

**Requirements:**

The site required for the construction of the WWTP and supplementary works is owned by the Hermosillo Water Utility. In the case of easements for the wastewater gravity main construction and WWTP access road, will be completed in existing right-of-ways.

### **Project Tasks and Timelines**

Once the BOT Contract is awarded, there will be a 30-month timeframe for the development of final designs, construction, start-up, and stabilization, and a 234 month timeframe for the operation.



**Figure 4. Construction Schedule for the Hermosillo WWTP.**

### 3.b Management and Operations

#### Project Management

**Resources:** The concessionaire of the facility will be the entity responsible for operation and maintenance of the plant wastewater treatment until it is transferred to the local water utility (*Agua de Hermosillo*) after the end of the concession period.

*Agua de Hermosillo*, the local utility, has the basic institutional, personnel, and financial capacity required to supervise and financially sustain the operation and maintenance of the proposed WWTP during the concession period, and to operate and maintain the wastewater treatment facility once the concession period is completed.

#### Operation and Maintenance

**Organization:** The project sponsor, *Agua de Hermosillo*, has an organizational structure that includes different Offices and Departments to carry out project management and development tasks.

**Operation plan:** Final designs will include an operation and maintenance manual establishing the primary tasks needed to ensure the proper operation of the system and to prevent deterioration in the proposed infrastructure.

**Permits, licenses, and other regulatory requirements:** The project sponsor has obtained the following documentation: Technical and financial validation from CONAGUA and BANOBRAS, and environmental clearance from SEMARNAT.

**Reviewing agencies:** CONAGUA, BANOBRAS, SEMARNAT, *Agua de Hermosillo*, BECC, NADB.

#### Pending Issues:

None.

#### Criterion Summary:

The project complies with BECC's Technical Feasibility criteria.

## 4. Financial Feasibility

### 4.a Proof of Financial Feasibility

#### Financial Conditions

**Information Submitted:** Local water utility Agua de Hermosillo 2005-2009 financial statements.

**Financial Analysis Results:** The payment mechanism proposed for the BOT, which includes a contingency line of credit is solid and low risk, therefore, the project is financially feasible.

A detailed discussion of the financial feasibility of the project is presented in the NADB Loan Proposal document for this project.

#### Project Total Cost, Financial Structure and Other Capital Investment Plans

**Item:** Design, construction and operation of a municipal wastewater treatment plant with a capacity of 2.5 m<sup>3</sup>/s.

**Final Cost:** **MX \$1,045 million**

#### Financial Structure:

Uses		Amount (Million MX pesos)	%
Project construction cost*		\$869.5	83
Interest capitalization		\$143.4	14
Other costs		\$32.1	3
<b>Total:</b>		\$1,045.0	100
Source	Type	Amount (Million MX pesos)	%
NADB	Loan	\$580.0	56
FONADIN **	Grant	\$233.8	22
BOT Contractor***	Equity	\$231.2	22
<b>Total:</b>		\$1,045.0	100

\* This cost estimate is based on the "Project Cost" defined in the BOT Contract, which is equivalent to \$761.9 million pesos at August 2010 prices and which has been adjusted for inflation throughout the construction period.

\*\* Grant provided by Mexico's Federal Government. FONADIN's commitment under the BOT Contract is equivalent to \$222.6 million pesos at August 2010 prices. This amount has been adjusted for inflation based on an approximate date for construction startup.

\*\*\* Pursuant to the bidding process, the BOT Contractor is required to fund at least 25% of the Project Cost or \$190.5 million pesos (25% of the aforementioned \$761.9 million at August 2010 prices). The \$231.2 million shown in the table includes this sum, as well as additional resources to cover indirect costs. Consequently, the BOT Contractor's contribution represents 26.7% of the Project Cost.

#### Dedicated Revenue Source

**Source of Income:** Revenues from Agua de Hermosillo (water utility), guaranteed by a contingency line of credit from the Municipality of Hermosillo.

#### 4.b Legal Considerations

**Project Management:** The concessionaire under the BOT contract will create a special purpose vehicle to finance, build and operate the wastewater treatment plant for the city of Hermosillo.

#### Pending Issues:

None.

#### Criterion Summary:

The project meets all applicable Financial Feasibility Criteria.



## 5. Public Participation

### 5.a Community Environmental Infrastructure Projects – Community-wide impact

#### Local Steering Committee

**Date of Establishment:** The Local Steering Committee (Consejo Consultivo Municipal) was formally installed on May 28, 2007, through the creation of the Internal Procedure of the Advisory Board of the Municipal Water Utility (Agua de Hermosillo).

**Local Steering Committee Members:** At a meeting of the Governing Board of the Municipal operating utility Agua de Hermosillo the current steering committee was installed consisting of the following members:

Chairman: C.P. Jose Antonio Diaz Quintanar  
Vice Chairman: Ing. Héctor Seldner Lizárraga  
Secretary: Lic. Juan Antonio de la Puente Bay

**Counsels:**

Lic. Martha Mada Fraire	Ing. Jorge Cruz Cons Figueroa
Ing. Marcos Gluyas Solórzano	Dr. Roman Miguel Moreno
Ing. Manuel Tapia Noriega	Ing. Fermín Chávez Pe u uri
Ing. Delfín Ruibal Corella	Ing. José Castillo Gurrola
Ing. Oscar Serrato Félix	Ing. Fernando Lopez Bernal
Lic. Jose Coppel Luken	Ing. Luis Guere a de la Llata
Arq. Gustavo Aguilar Beltran	C.P. Iván Peralta Toyos
Ing. Jorge Gómez del Campo	Ing. Mariano Morales Monta o
Ing. Jesús Almeida Flores	

Commissioner  
C.P. Rubén Salas Griego

Public Commissioner  
Ing. Alberto Torres Soto

#### Public Access to Project Information

**Public access to project information:** The project sponsor has an established public participation process which includes an appointed advisory board, as described above, regularly scheduled meetings to share anticipated utility investments and decisions, and an established forum, through internet and other media, for sharing these items with the general public. Based on BECC's determination that the existing process has been sufficiently implemented in the same intent as the community participation criterion, a specific a public participation plan was not required for this project.

**Final Public Participation Report**

**Final report:** BECC reviewed and validated the public participation activities conducted by the sponsor in its normal development of the project and found that those actions were consistent with the criterion. Evidence of this process has been gathered and archived which supports the compliance determination with the criteria established, and thus no additional final report will be required.

**Post-Certification Public Participation Activities**

**Post-Certification Activities:** The project sponsor, in coordination with the Local Steering Committee, will provide a general description of public participation activities that may be carried out after the project's certification to support its implementation and long-term feasibility.

**Pending Issues:**

None

**Criterion Summary:**

The project complies with BECC's Public Participation Criteria.

## 6. Sustainable Development

### 6.a Human and Institutional Capacity Building

**Project operation and maintenance:**

The operation and maintenance of the proposed Wastewater Treatment Plant will be the responsibility of the concessionaire until the facility is transferred to the local water utility (*Agua de Hermosillo*) at the end of the concession period.

*Agua de Hermosillo*, the local utility, has the basic institutional, personnel, and financial capacity required to supervise and to afford the operation and maintenance of the proposed WWTP during the concession period, and to operate and maintain the wastewater treatment facility once the concession period is completed.

**Human and institutional capacity building:**

Actions within the scope of the project that contribute to improving the institutional and personnel capacity of *Agua de Hermosillo* include:

- Providing and improving wastewater collection services under a continuous, efficient, and cost-effective approach.
- Providing basic technical training to the staff to be in charge of the project's operations and maintenance.
- Operating a wastewater treatment system that meets current regulations and standards.
- Capacity building for the utility's operating staff throughout its different fields to provide essential services to meet the needs of the community.

### 6.b Conformance to applicable Local, State, and Regional Regulations and Conservation and Development Plans.

**Local and Regional Plans addressed by the project:**

The proposed project conforms to applicable plans and actions described in the following documents:

- Sonora State Water Law (Law 249)
- State Development Plan.
- Municipal Development Plan.
- Urban Development Program for the Hermosillo Population Center

### 6.c Natural Resource Conservation

The project contributes to the reduction of environmental deterioration by completely eliminating raw wastewater discharges from the city of Hermosillo, and promoting water reuse and aquifer recharge, as well as creation of additional park grounds. These actions will not only reduce aquifer contamination and potential

human health risks, but will also improve the environment in general.

## **6.d Community Development**

Project completion is crucial for the community development. The proposed tasks will contribute to appropriate wastewater disposal, which will reduce conditions that influence the spread of waterborne and arboviral diseases.

### **Pending Issues:**

None

### **Criterion Summary:**

The project complies with the Sustainable Development Criteria.

### **Available Documents**

- Finding regarding environmental clearance for the Hermosillo Wastewater Treatment Plant, issued by SEMARNAT-Sonora Office, through Official Communication No. DS-SG-UGA-IA-0354-09, on May 12, 2009
- Technical and financial validation of the Preliminary Engineering for the construction of the Hermosillo Wastewater Treatment Plant, issued by CONAGUA and BANOBRAS. 2009.
- Wastewater Treatment Plant for the City of Hermosillo, Sonora. Bid RFP documents and meetings minutes