Annex I

Terms of Reference

Objectives

The Regional Government of Lambayeque (Gobierno Regional de Lambayeque, "GRL") aims to mitigate flooding of the La Leche River created by the periodic occurrence of the El Niño meteorological phenomenon. The objectives of the Feasibility Study ("Study") are to analyze alternatives for developing a comprehensive flood control project ("Project") for the La Leche River watershed, and to select the optimal alternative. The Study will give GRL the opportunity to identify the investments they need to undertake to develop a multiple-use project, which would control flooding, improve water conservation and storage, increase the supply of irrigation water, and eventually increase the supply of potable water.

The Study will:

1. Analyze the alternatives proposed by GRL to develop a comprehensive flood control project for the La Leche River watershed (including a monitoring program), propose new alternatives, and determine the optimal alternative.
2. Analyze the potential to use the water storage capacity created by the Project to irrigate agricultural lands and to eventually supply potable water to communities in the La Leche River watershed.
3. Identify the stream of costs and benefits to be included in the cost/benefit analysis.
4. Prepare preliminary designs of the Project, including cost estimates and an implementation schedule.
5. Conduct an economic analysis of the Project to demonstrate that the optimal alternative has a positive net present value ("NPV").
6. Prepare financial projections of the Project based on the guidelines of the most likely sources of financing.
7. Conduct a preliminary environmental impact assessment based on the guidelines of Peru's National Environmental Council (Consejo Nacional del Ambiente, "CONAM"), or any other internationally recognized entities, such as the U.S. Environmental Protection Agency.

Activities

Task 1: Preliminary Field Work and Data Collection

1.1 Document Review: The Contractor shall review all available documents related to a proposed flood control project in the La Leche River watershed in the Lambayeque region, including any hydrological models presented in previous studies. Special attention should be given to the 1993 pre-feasibility study prepared by GRL and to the potential environmental impacts of the Project.

1.2 Field Work: The Contractor shall examine the proposed physical locations of the dams included in the alternatives proposed by GRL, and shall become familiar with the geology of the proposed locations on a first-hand basis. The Contractor shall propose new alternatives as needed and shall examine their proposed locations as well.

1.3 Locations and Approaches: Using a large-scale map (1:20,000 or other scale used in the U.S. engineering industry and approved by GRL), the Contractor shall prepare diagrams of the alternatives to be compared in Task 2.

Deliverable: Initial Report, covering all activities conducted during Task 1 and including a detailed schedule for Study completion.

Task 2: Comparison of Alternatives

2.1 The Contractor shall assess all of the alternatives identified in Task 1 and shall define the basic components of each alternative. The Contractor shall carry out preliminary hydrological and geological investigations sufficient to support the characteristics, design parameters, and sizing of the alternatives.

2.2 The Contractor shall estimate the cost of each alternative (in the range of +/- 30%).

2.3 The Contractor shall carry out a preliminary overview of the potential environmental impact of each alternative.

2.4 The Contractor, in consultation with GRL, shall select the optimal alternative in accordance with the following criteria:

a) the most effective and efficient in terms of desired results;
b) the lowest economic cost at present value;
c) the highest NPV, and;
d) an internal rate of return ("IRR") of at least 12% (using a discount rate of 12%).

2.5 The Contractor shall estimate the cost of the selected alternative (in the range of +/- 20%) and shall assess the viability of the optimal alternative in accordance with the following guidelines:

2.5.1 Preliminary investigations

- Prepare topographic maps of the Project location (at a scale of 1:2,000 or other scale used in the U.S. engineering industry and approved by GRL).
- Perform a detailed field structural geology investigation, including sub-surface explorations.
- Ascertain and describe the conditions that will be encountered during construction of the dam.

- Estimate and model the runoff and define whether appropriate flood control requires more than one reservoir.

2.5.2 Foundation exploration

- The Contractor shall assess the situation and shall define the optimal manner to explore the foundation. For simple structural geology, diamond drilling is sufficient. Where the conditions are less defined, drilling of large diameter holes or the sinking of shelves will be necessary.
- The drilling of holes shall reach bearing bedrock. Some of the borings shall be drilled deep enough to discover structural failure potential, particularly in sedimentary rocks.

2.5.3 Geology of the site and dam location

- The Contractor shall locate all faults and other structural geology features on the topographic maps, taking dam design into account. Note that the best location for a gravity dam is usually in the narrowest section of the river valley, provided that the geology is appropriate.
- The form of the dam shall be defined based on the topographic characteristics of the bearing rock surface.

Deliverable: Interim Report No. 1, covering all activities conducted during Task 2 and including all supporting materials (such as documents and maps) used to compare the alternatives and select the optimal alternative.

Task 3: Preliminary Designs of the Construction Works

The Contractor shall prepare the preliminary designs of the optimal alternative selected in Task 2, including dam(s), reservoir(s), and related works.

3.1 Earth-fill dam

The preliminary design shall ensure that the dam section and foundation result in a stable and sufficiently water-tight structure. The Contractor shall consider, the following requirements, among others:

a) Spillways and outlet considerations;
b) Site and laboratory investigations;
c) Choice of section;
d) Foundation types such as on rock, pervious, impervious over rock, impervious over pervious, and stratified;
e) Earthquakes considerations;
f) Embankment types;
g) Availability of impervious materials;
h) Non-uniform materials;
i) Water-tight elements;
j) Methods of construction;

k) Hydraulic design;
l) Rock toes and drainage blankets;
m) Drainage wells and trenches;
n) Structural design;
o) Cohesion-less materials;
p) Slope protection;
q) Sub-surface investigations;
r) Sampling;
s) Permeability tests.

3.2 Rock-fill dam

The Contractor shall also consider the use of a rock-fill dam, considering the following requirements, among others:

a) Availability of suitable materials for the embankment fill;
b) Foundation;
c) Necessity for separate spillway and outlet works;
d) Earthquakes;
e) Design criteria such as:
    i) Crest width;
    ii) Face slopes;
    iii) Masonry section;
    iv) Loose rock-fill impervious membrane on upstream face;
    v) Impervious core walls;
    vi) Provisions against sliding;
    vii) Residual free board;
    viii) Settlement and factors affecting settlement and provisions.

3.3 Spillway

Several types of spillways are used, such as over-fall spillways, chute spillways, side channel spillways, shaft spillways, spillways tunnels, morning glory, and siphon spillways; and numerous hydraulic models are available. The Contractor shall consider the following requirements, among others, to ensure proper operation of a reservoir:

a) Selection of inflow design flood;
b) Relation of surcharge to spillway capacity;
c) Flood routing;
d) Selection of spillway size and type;
e) Selection of the spillway layout;
f) Control structure;
g) Discharge channel;
h) Terminal structure;
i) Entrance and outlet channels;
j) Crest structures and walls;
k) Miscellaneous details such as cutoffs, backfill, and rip-rap;
l) Scour protection;

m) Energy dissipation;
n) Hydraulic model tests.

3.4 Additional criteria

The Contractor shall consider the following requirements, among others:

a) Sedimentation, evaporation, and seepage of the reservoir shall be appropriately estimated in the preliminary design.
b) Area controlled by the reservoir, reservoir capacity, and outlet discharge.
c) Area-volume curves, hydrographs, duration curves, mass curves, effect of valley storage, and flood routing shall be used as appropriate for the preliminary design of the reservoir.
d) Estimated peak flow. The Contractor shall determine the most suitable equation or method (such as Burkli-Ziegler Equation, Meyer's Equation, Talbot Equation, Rational Method, or other recognized equation or method used in the U.S. engineering industry or academia and approved by GRL) to estimate the peak flow.

Deliverable: Interim Report No. 2, covering all activities conducted during Task 3.

Task 4: Environmental Impact Assessment Methodology

The Contractor shall review the following considerations prior to undertaking the Environmental Impact Assessment ("EIA"):

- The preparation of an EIA consists of numerous activities, investigations, and technical tasks to identify the main environmental consequences of the project comparing the situation "with" and "without" the project. This approach should not be confused with the situation "before" and "after" a project.
- Many methodologies exist to identify, appraise, and summarize the environmental impacts of a project, such as:
    1. The ad-hoc methodology is generally used when the timeframe is short and is carried out by a group of experts that evaluate the project and identify the impacts.
    2. The check-list methodology consists of the preparation of a list of all the environmental impacts generated by the project. Check-lists are currently used in environmental diagnostics and to compare alternatives. The check-list numeric values are used to indicate the intensity of the impacts varying from 1 to 3 (3 being the most-intensive impact). This methodology permits establishment of cause and effect relationships using both qualitative and quantitative assessment parameters.
    3. The interaction matrix is a more-complete methodology in which the list of impact factors is included on the "X" axis and the list of activities for the construction and operational phases of the project is included on the "Y" axis. The matrix may consist of an extensive list of environmental impacts and an extensive list of project activities, resulting in cells in each of which the intensity of the impact is estimated using a pre-selected range

of values. The list of impacts and their intensity can be observed at the end of the exercise. Moreover, the magnitude of an impact and its importance are presented.

- The Inter-American Development Bank's appraisal methodology for investment projects requires that all environmental impacts are quantified and are included in the cost/benefit analysis.

The Contractor, in consultation with GRL, shall select the most appropriate EIA methodology to employ. GRL may invite stakeholders to participate in the development of the EIA methodology.

Deliverable: Interim Report No. 3, covering all activities conducted during Task 4.

Task 5: Environmental Impact Assessment Report

The Contractor shall prepare an EIA report of the optimal alternative selected in Task 2 in accordance with the EIA methodology selected in Task 4, and shall organize the EIA report as follows:

a) Executive summary
b) Purpose
c) Background
d) Project location, described in detail:
   i. Physical setting: topography, geomorphology, geology, rivers, lakes, hydrographic basins, archaeological ruins, water quality, air quality, noise, and hazardous residues.
   ii. Biological setting: ecosystems, habitats, migration, natural reserve areas, human populations, flora and fauna, flooding areas, swamp and wetland areas, and endangered species.
   iii. Human resources setting: demography, economy and development, land use, infrastructure, housing, schools, health care, transportation, fishing, recreation, public services, and archaeological and historical resources.
e) Description of the environmental legislation and identification of the applicable Host Country environmental authority. In Peru, CONAM has developed guidelines for the presentation of EIAs. The Contractor shall obtain this information and shall adhere to the requirements.
f) Description of the most relevant parts of the alternatives comparison study conducted in Task 2 shall be included in a comprehensive manner to permit the reader of the EIA report to have a clear understanding of the Project without consulting additional documentation.
g) Description of the environmental impacts: positive and negative, reversible and irreversible, and permanent and temporary. Environmental impacts during the construction phase shall be included.
h) Quantification of the environmental impacts, which shall be included in the cost/benefit analysis.
i) Identification and quantification of the mitigation measures for negative environmental impacts shall be included.

j) Description of the environmental impact mitigation plan, including methodology for its implementation, schedule, preparedness action program, monitoring and ancillary monitoring equipment, training, and human and economic resources required. Special attention shall be given to mitigating the impact on human populations and existing settlements.

Given that community outreach and public participation are important for the success of the Project, the Contractor shall assist GRL with public seminars and presentations during the preparation of the EIA report and GRL shall make the results of the EIA report public.

Deliverable: Interim Report No. 4, covering all activities conducted during Task 5.

Task 6: Cost/Benefit Analysis

The Contractor shall conduct a cost/benefit analysis of the Project that covers economic, financial, and social factors and reflects a multiple-use project (flood control, river water level regulation, potable water supply, and irrigation water supply). The costs and benefits shall be measured using shadow prices (efficiency costs) and NPV (using a discount rate of 12%). The IRR shall also be determined and shall be no less than 12%. A sensitivity and risk analysis on the NPV and IRR shall be carried out to expose variations in the main parameters and assumptions utilized. Depending on the location of the dam(s) and the amount of water storage obtained, the stream of costs and benefits of the selected alternative shall be estimated.

Examples of benefits might be:

i) Economic losses avoided by implementing the Project, and;
ii) Value of the additional irrigation water and agricultural land.

Examples of costs might be related to:

i) Dam(s) and related works;
ii) Irrigation water projects;
iii) Land for the water storage reservoir, and;
iv) Environmental impact and mitigation.

To obtain the economic cost, the following items shall be considered:

a) Investment costs, by year, separated into the following categories:
   - Foreign exchange;
   - Local and imported equipment;
   - Local and imported materials;
   - Skilled and unskilled labor;
   - Land, and;
   - Energy.
b) Periodic replacement costs by year;
c) Incremental costs, by year, covering administration, operation, and maintenance, and;

d) Other costs such as residential connections, land, contingencies, engineering and administration, and rights of way. Financing costs, inflation, depreciation, and taxes shall not be considered.

All costs shall reflect the opportunity costs of resources in the Host Country. For that purpose, market costs shall be converted to frontier costs using the corresponding conversion factor for tradable and non-tradable commodities.

Deliverable: Interim Report No. 5, covering all activities conducted during Task 6.

Task 7: Potable Water Cost/Benefit Analysis

The Contractor, in consultation with GRL, shall conduct a potable water expansion plan to serve communities in the La Leche River watershed. The potable water expansion plan shall cover a 20-year period and shall determine the volume of water to be used for human consumption. The volume of water to be used for human consumption will be added to the storage capacity of the reservoir, the two primary objectives of which are flood control and irrigation.

The Contractor shall develop a methodology for and conduct a cost/benefit analysis of the potable water expansion plan.

Deliverable: Interim Report No. 6, covering all activities conducted during Task 7.

Task 8: Financial Projections

The Contractor, in consultation with GRL, shall identify the most likely sources of financing and shall develop 10-year financial projections (starting at the first year of Project construction) depending on the sources of financing identified.

As an example, multilateral development banks request the following information:

a) Start year of project construction;
b) End year of project construction;
c) Source and financial security of the Host Country counterpart project sponsor;
d) Grace period (during project implementation, the borrower usually pays only the commitment fee and interest);
e) Number of years to repay the loan (usually about 25 years), and;
f) Sources and financial security of Host Country funds (such as taxes, government grants, and tariffs) and an estimate of the amount needed annually to repay the loan.

Deliverable: Interim Report No. 7, covering all activities conducted during Task 8.

Task 9: Development Impact Assessment

For the benefit of those interested in the Project, the Contractor shall assess the development benefits associated with the Project and the methodology for measuring those benefits. The assessment shall include examples of the development benefits that would be expected in the Host Country if the Project is implemented as outlined in the Final Report. If multiple scenarios are discussed (such as various alternative implementation scenarios based on the level of investment), the Contractor shall separately outline the development benefits that would be expected in each scenario. The Contractor shall specifically focus on examples from the categories listed below and shall develop a methodology for assessing these impacts over time. The Contractor shall select examples that USTDA could reasonably expect to be able to obtain information on in the future and shall make suggestions as to where USTDA should look to obtain this information (e.g. GRL, trade statistics, or U.S. Embassy in the Host Country). The Contractor shall only list benefits in the categories that are applicable to the Project.

For example, a flood control project of sufficient magnitude and of the appropriate type could preserve or increase agricultural production and irrigated land; and protect human health, the environment, flora and fauna, and vulnerable infrastructure. A flood control project may also have a positive impact on the economic development of the area.

The categories to be considered are as follows:

Infrastructure: Improvements in physical infrastructure that would result from the Project. Estimate the scale of construction expected and comment on the capabilities of any recommended infrastructure improvements.

Human capacity building: Estimate the number and type of jobs that would be created during the construction phase if the Contractor's recommendations are implemented. Distinguish between temporary construction jobs and the number of jobs that would be created or sustained once construction is complete. Comment on any prospective training recommended in the Study, including an estimate of the number of persons to be trained, type of training needed, and the desired outcome of the training.

Technology transfer and productivity impacts: Discuss any commercial contracts for new technology that are recommended, as well as the expected productivity benefits of any such technology. More generally, discuss the expected efficiency gains related to the recommendations, such as enhanced productivity or more efficient use of resources.

Market-oriented reform: Discuss any market-oriented reforms that would facilitate implementation of the Project or that would result from implementation of the Project, which may include concessions and public-private partnerships.

Deliverable: Interim Report No. 8, covering all activities conducted during Task 9.

Task 10: Final Report

The Contractor shall prepare and deliver to GRL and USTDA a substantive and comprehensive final report of all work performed under these Terms of Reference ("Final Report"). The Final Report shall be organized according to the above tasks, and shall include all deliverables and documents that have been provided to GRL. The Final Report shall be prepared in accordance with Clause I of Annex II of the Grant Agreement and shall identify prospective U.S. sources of supply. The Final Report shall be prepared in the English and Spanish languages.

Notes:

(1) The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of the Terms of Reference.

(2) The Contractor and GRL shall be careful to ensure that the public version of the Final Report contains no security or confidential information.

(3) GRL and USTDA shall have an irrevocable, worldwide, royalty-free, non-exclusive right to use and distribute the Final Report and all work product that is developed under these Terms of Reference.