

DRAFT

**Advice on Terms of Reference
for an EIA for the complemen-
tary dredging
of the Amaluza Reservoir
- Ecuador -**

x Month 2007 / 070-xxx/ ISBN xxx-421-xxxx-xxx

CONTENTS

1. INTRODUCTION	3
1.1 The Initiative: Complementary dredging of Amaluza reservoir, Ecuador	3
1.2 Request of FMO and involvement of the Commission	3
2. PROBLEM ANALYSIS AND PROJECT OBJECTIVES.....	4
2.1 Problem analysis	4
2.2 Project objectives	5
3. PROJECT SETTING.....	6
3.1 Legislative and regulatory considerations and policies	6
3.2 Institutional and procedural framework	6
3.3 Public and agency involvement.....	6
4. DESCRIPTION OF THE PROJECT AND ALTERNATIVES.....	7
4.1 General.....	7
4.2 Project activities and alternatives	8
4.2.1 Preparation.....	8
4.2.2 Dredging.....	8
4.2.3 Sediment disposal and sediment transport capacity	9
5. DESCRIPTION OF THE NATURAL AND SOCIO-ECONOMIC ENVIRONMENT AND ITS AUTONOMOUS DEVELOPMENT	9
5.1 Natural environment.....	9
5.1.1 Physical aspects (paragraph 3.2.2.1 of ToR Hidropaute)	9
5.1.2 Biological aspects (paragraph 3.2.2.2 of the Hidropaute ToR) 10	
5.2 Socio-economic environment	10
6. IMPACTS.....	11
6.1 General.....	11
6.2 Impacts on the natural environment	11
6.3 Impacts on the socio-economic environment	12
6.4 Project related risks	12
7. COMPARISON OF IMPLEMENTATION ALTERNATIVES	12
8. GAPS IN INFORMATION AND KNOWLEDGE.....	12
8.1.1 Flushing of the sediment.....	13
8.1.2 Downstream disposal of the sediments	13
8.1.3 Required studies	14
9. ENVIRONMENTAL MANAGEMENT PLAN.....	14
10. MONITORING AND EVALUATION.....	15
11. FORMAT AND PRESENTATION OF THE EIA REPORT	15

APPENDICES

1. Letter with request for advice from FMO, 23 August 2006
2. Project information and composition of the Commission's working group
3. Working programme 11-15 December 2006
4. Map of the area
5. List of documents used
6. Pictures of site visit

1. INTRODUCTION

1.1 The Initiative: Complementary dredging of Amaluza reservoir, Ecuador

A Netherlands dredging company applied for ORET¹-grants for a dredging campaign of around 20 million cubic meters from the Amaluza reservoir in the Paute river in Ecuador (see map, appendix 4). This has been done at the request of Hidropaute S.A., a dedicated state company for the Hidropaute complex, being the Daniel Palacios dam and Amaluza reservoir.

The proposed project aims at eliminating the risk of obstruction of the water intake and bottom drain located in the dam, due to the collapse of the sediment that has been deposited in the vicinity of these, as well as to recover part of the maximum buffer capacity of the reservoir, which specifically means the following:

- Safeguard the operation of water intake and the bottom valves against a potential collapse of the sediment that has accumulated near the dam, which could be generated by a collapse of sediments located between km. 1 and 6;
- Recover to the maximum degree possible, the volume of the reservoir.

1.2 Request of FMO and involvement of the Commission

FMO Finance for Development² executes the ORET-programme, on behalf of the Dutch Ministry of Foreign Affairs. FMO assesses ORET applications on financial, technical and organizational feasibility, as well as the investments contribution to sustainable development of the country. This implies that FMO requires a proper assessment of environmental and social impacts of the proposed project. To obtain this assessment, FMO solicited assistance from the Netherlands Commission for Environmental Impact Assessment (EIA)³, (see letter appendix 1).

More specifically, FMO invited the Commission to:

- Review a proposal for Terms of Reference for an EIA report, which already has been prepared by Hidropaute (dd. 22 November 2006) and to supplement these if needed;
- Perform an independent quality review of the EIA report once finalized;
- Take into consideration the Ecuadorian EIA requirements, as well as those of the Corporación Andina de Fomento (CAF)⁴ in order to align

¹ Development Related Export Transactions

² Netherlands Finance Company for Developing Countries

³ Henceforth referred to as 'the Commission'

⁴ By e-mail of 18 September, CAF stated that they work with the national environmental legal framework

procedures in such a way that one report fulfils the needs and requirements of all parties involved.

In order to prepare an advisory report on this specific request, the Commission formed a working group of experts, representing the Commission, which comprises the following disciplines: dredging, civil and hydraulic engineering, nature conservation, social impacts and EIA application. The working group members of the Commission are listed in appendix 2.

In November 2006, this working group met with the dredging company and FMO in the Netherlands. On this occasion, a presentation of the project took place and a questions and answers session was held.

Subsequently, the working group visited Ecuador from 11-16 December 2006 (see appendix 3, programme). The purpose of this visit was to collect project- and site specific information (see appendix 5, list of documents) and discuss matters with several (government) authorities and local population. More specifically, the visit was organised to:

- Scope the relevant environmental and socio-economic issues to be taken into account;
- Review the available documentation, more specifically several EIA reports that already have been prepared for activities that have a close relation with this project.

Below the Commission presents the findings. In each paragraph the Commission, if possible, refers to the ToR of Hidropaute, the already available information on the topic and gives a judgement on its quality. The Commission also specifically formulates recommendations or guidelines for additional information that still needs to be gathered in order to guarantee that all essential environmental and socio-economic information has been provided for sound and well balanced decision making. The Commission wants to emphasize that it has no opinion on the feasibility or acceptability of the project.

2. PROBLEM ANALYSIS AND PROJECT OBJECTIVES

2.1 Problem analysis

In the EIA report, the problems which are assumed to be solved by realisation of the project should be stated in clear terms and the underlying causes should be analysed. The EIA report can refer to the information presented in the feasibility study in par. 2.1 Background and problem description. The following issue needs further attention:

- The main reason to do the project is the fear that the sediments that have accumulated in the reservoir will liquefy and block the intakes of the turbines. Loss of reservoir capacity is also mentioned as a problem. After construction of the Mazar reservoir sediment inflow will greatly reduce. The EIA report should state whether the fear for liquefaction is justified and whether dredging of 20 million m³ of sediments is the only possible measure to reduce this risk.

In addition, in the problem analysis at least the following aspects should be addressed, especially in relation to the long term sustainability of the project intervention:

- The relationship with the Mazar dam under construction, situated 18 km. upstream of the Daniel Palacios dam. This dam is built to regulate the inflow of water in the Amaluza reservoir and will retain most of the sediments that currently flow into the Amaluza reservoir. The documentation mentions different dates as to when the dam is expected to be ready, which influences timing and planning of the current dredging project. The correct information should be provided in the EIA report;
- Relationship and possible interference with other future projects (e.g. the Sopladora project and river training and erosion control measures in Mendez);
- Status of river basin management (Cuenca hidrográfica del río Paute), which is vital to increase the life time of any hydroelectric power plant. Is continuity and expansion of river basin management activities foreseen or guaranteed? How does this influence the dredging project (e.g. risks of landslides)?;
- Justification for the selection of the current dredging project as the best solution out of several project alternatives (a clear and transparent summary should be made of the findings of e.g. the 'Estudio expost de impacto ambiental' of 2002, and the Hidropaute document 'Dragado complementario' of June 2003). It should be clearly stated whether and how environmental considerations played a role in the selection.

2.2 Project objectives

According to the project documents, the main objective of the initiative is to eliminate the risk of obstruction of the water intake and bottom outlets located in the dam, due to the collapse of the sediment that has been deposited in the vicinity of these, as well as to recover the capacity of the reservoir.

The project activities are restricted to dredging and sediment disposal. Therefore, the EIA report should clearly address preconditions for successful implementation of the project (such as timely construction of the Mazar dam), but also indicate required follow up and/or parallel activities to fully contribute to the solution of the problems as identified in the preceding section (such as proper river basin management to prevent or reduce erosion rates).

The EIA report must contain a clear definition of the objectives of the proposed activity to enable identification and formulation of implementation alternatives and to furnish criteria for monitoring and evaluation. The objectives should be specific and if possible quantified.

3. PROJECT SETTING

3.1 Legislative and regulatory considerations and policies

The EIA report must describe national laws, rules, regulations and policies governing the proposed activity and if relevant, international conventions and regulations. The ToR prepared by Hidropaute already provide an overview (see paragraph 2.3, point 1). The EIA report should also include and respect the specifications of the new regulations about citizen participation (Reglamento de Participación Ciudadana) in EIA's and the Ley Orgánica de Transparencia y Acceso a la Información Pública, both meant to guarantee the right of the public to be informed and to participate in decision making.

The EIA report should indicate which of these are specifically applicable to this project, including preconditions these may put on the project.

The EIA report should also assess the probability of compliance of the intended activity with the above mentioned legislative and regulatory considerations and policies.

3.2 Institutional and procedural framework

The EIA report must give a clear description of the institutional framework in Ecuador, including competent (licensing) authorities directly involved in the approval and execution of the project and in the control of the executed works, such as CONELEC (Consejo Nacional de Electricidad) and the Ministry of Environment.

The EIA report must also indicate which competent (licensing) authority is committed to the follow-up activities once project activities are finished and how maintenance of e.g. mitigation measures taken will be secured.

3.3 Public and agency involvement

The EIA report must contain an inventory and description of all stakeholders involved in or affected by the project and how their opinions and interests did influence the contents of the EIA report. At least the views of the following stakeholders should be taken into account:

- Local inhabitants and their organizations of the villages and communities located alongside the road between the Amaluza reservoir and the village of Mendez. Special attention should be given to the villages (parroquias) Amaluza and Santiago de Mendez. The first is located very near the reservoir dam and the dredging activities and should therefore participate in the definition of alternatives, especially during the preparation phase. The village of Mendez is located downstream in an area that can possibly be affected negatively by deposition of sediments. Especially in this village, already suffering the effects of previous works and natural disasters, a participatory process should take place to ensure that the population is duly informed and consulted about project activities. Its opinions and contributions have to be taken into account in the definition of alternatives and the environmental management plan;

- Local and regional authorities, such as mayors, municipal councils, village councils and their presidents, communal presidents, local priests;
- Regional and national organizations involved in projects or other activities in the project area, such as NGO's, including possible activities of the agro ecological network Red Agroecológico del Austro, that represents NGO's and peasant organizations. In addition, environmental groups or movements active in the project area should be consulted;
- The Consejo de Gestión de Aguas de la Cuenca del Paute (CGPaute), representing various organizations active in the Paute watershed.

The EIA must indicate in which way the stakeholders are involved in the project, its environmental management plan and follow-up.

According to regulations of CONELEC (Reglamento Ambiental para Actividades Eléctricas) and the Environment Ministry (Texto Unificado de la Legislación Ambiental secundaria), the EIA report must consider participation of the affected villages and communities in different phases. Meetings will have to be held with these and other stakeholders to inform and consult them, taking into account the specifications of the new regulations about citizen participation (Reglamento sobre la Participación Ciudadana y Consulta previa) in EIA's.

4. DESCRIPTION OF THE PROJECT AND ALTERNATIVES

4.1 General

The feasibility study gives an overview of project activities, namely:

- Modification of dredging equipment;
- Procurement of electrical equipment, pipelines and water hyacinth removal equipment;
- Mobilisation of dredging equipment;
- Installation of equipment on site;
- Cutting of water hyacinth vegetation;
- Dredging operations;
- Survey quality control and environmental monitoring;
- Dismantling and
- Demobilisation of equipment.

The EIA report should contain a clear and extensive description of the project activities as mentioned above, including also the disposal of the sediments and possibly disposal of the water hyacinth vegetation. Use can be made of the information provided in form 6-T 'Approach, scope and work methodology of Boskalis'.

4.2 Project activities and alternatives

4.2.1 Preparation

Activities

Some activities are relevant for project start up. The EIA report must therefore describe:

- Assembly and installation of equipment on the site, including pipelines and high voltage energy supply system;
- Establishment of workshop/storage/service area for fuels, spare parts, equipments etc.;
- Installation of anchoring points for the dredge anchors;
- Removal of the water hyacinth and disposal of the resulting biomass (e.g. on the shore, settling on the reservoir bottom);
- Improvement (and possible new construction) of access roads;
- Location and design of campsite;
- Timing and coordination of the works.

Alternatives

The EIA report should address relevant alternative options for each of the points mentioned above, in terms of location, routing and methods applied. The EIA report should also justify the selected alternative and indicate in which way environmental and social considerations have been taken into account.

4.2.2 Dredging

Proposed activity

The EIA report must describe the following aspects of the dredging activities, making use of the documents mentioned in paragraph 3.2.1 of the ToR of Hidropaute. Special attention must be paid to:

- Justification for the selection of areas to be dredged and the depth and volume that will be dredged;
- Method and equipment used for dredging;
- Way of operation: planning (annual and over the whole project period) of dredging operations in relation to location, season and sediment composition;
- Operation schedule (full continuous or daylight schedule);
- Total duration of the dredging activity;
- Labour requirements and (local) labour availability;
- Number and route of movements for supply of fuels (in case of diesel powered dredge);
- Emergency plan in case of spills (diesel, grease, oil) and calamities.

Alternatives

The EIA report should address relevant alternatives such as:

- Positioning options of the dredge to influence seasonal distribution of fine and coarse sediment extraction to maximize downstream sediment transport (see also Chapter 8, Gaps in knowledge).

4.2.3 Sediment disposal and sediment transport capacity

According to the project, sediments will be deposited in the riverbed directly downstream of the Daniel Palacios dam. At present, it is uncertain whether the sediments will be transported downstream or accumulate at the pipeline outlet site. This issue requires ample attention and further studies (see also chapter 8).

Proposed activity

The EIA report must describe:

- Method and equipment for transport of dredged material, including floating and land-based pipelines, and booster stations;
- Distance of transport (by pipeline);
- Timing of disposal; which amounts of sediments and which grain size distribution will be deposited in which period (see chapter 8).

Location alternatives

Given the above described uncertainty related to the downstream transport of the sediment, alternatives for the sediment disposal should be described in terms of location, routing and design of the pipelines. Possible alternatives may include extension of the pipeline to km 5.6 (Rio Negro) or km. 12 (downstream of the turbine outflow) either along the road, along the valley slope or along the river bed. Another alternative could be construction of a tunnel to discharge the sediments to a location downstream of km. 5.6 or km. 12.

Alternatives to increase sediment transport capacity of the river

Several options should be considered (see chapter 8 for details) such as:

- Optimised flushing of the sediment;
 - by using the annual spill regime to flush course sediments in the wet season;
 - by providing additional discharge via the spillways when the sediment accumulation reaches pre-defined quantities;
 - by diverting the flow of the Rio Negro (km 5.6) to the pipeline outlet site.

5. DESCRIPTION OF THE NATURAL AND SOCIO-ECONOMIC ENVIRONMENT AND ITS AUTONOMOUS DEVELOPMENT

5.1 Natural environment

The ToR of Hidropaute in its paragraph 3.2.2. gives an overview of issues to be addressed in the EIA report. This overview is fairly complete for the physical and biological aspects. A few additions are recommended below.

5.1.1 Physical aspects (paragraph 3.2.2.1 of ToR Hidropaute)

Geomorphology and erosion:

- Describe the average annual sediment inflow in the reservoir during construction of the Mazar Dam and after finalization of the works. This to judge the sustainability of the proposed dredging works;
- The mentioned study of the social consequences of the sediment disposal is not relevant in this chapter.

Hydrology and sediments

- Not only the hydrology (discharges, sediments) of the River Paute, but also of the tributaries in the stretch between the Palacios Dam and the confluence with the Rio Negro downstream of Mendez should be described.

Water and air quality

- At the moment bad odours are reported, probably related to the presence of water hyacinth or disposal of the harvested pest. A general description of this problem should be given.

5.1.2 Biological aspects (paragraph 3.2.2.2 of the Hidropaute ToR)

Vegetation

- Protected areas and rare and endangered species.

Fauna

- Aquatic fauna has to be described in the same way as the terrestrial fauna.

5.2 Socio-economic environment

The EIA report must describe the relevant socioeconomic situation in the project area with emphasis on the villages and communities located alongside the road between the Amaluza reservoir and the village of Mendez, basically using secondary information from the national census, the Ecuadorian Social Indicators System SIISE, Provincial and Municipal Development Plans, previous EIA reports and other studies. The ToR of Hidropaute in its paragraph 3.2.2.3 do not specify which information is needed on the socio-economic situation. It is recommended that the EIA report provides information on:

Demography:

This information will expose the aspects that determine the populations possibilities to engage in temporary or permanent jobs and day labour in the project. That includes:

- Total population in villages and communities of the project area;
- Population structure, sex ratio, density, growth;
- Educational level, illiteracy;
- Working population and economic sectors;
- Migration patterns.

Economy:

This information will expose the present situation of agricultural practices and other economic activities that might affect the sustainability of the project or could be impacted by it. That includes:

- Economic activities of both men and women, including agriculture, cattle breeding, day labour in hydroelectric plants and others;
- Importance of mining activities, tourism, services and others;
- Seasonal changes in activities;
- Land use and natural resources use;
- Land tenure and legal status;
- Relation to and use of the Paute River (e.g. sand and gravel mining, irrigation and fishing);

- Relation to and use of the National Park Sangay and protection forests ('bosques protectores') alongside the Paute River;
- Accessibility.

Social and living conditions:

This information is necessary to understand the present living conditions, social organizations and relations of the population in the project area and to assess the way these might be affected by the works.

- Political and administrative division;
- Services quality and accessibility (water supply, waste/water disposal, energy supply, social services like health and education);
- Living conditions (e.g. size of plots, houses and households);
- (In)formal social organization of the inhabitants, including role of women;
- Presence and role of ethnic minorities (Shuar);
- Sites with historical, archaeological or cultural interest.

If secondary information is not available for the project area, the EIA report must investigate relevant socioeconomic conditions locally.

6. IMPACTS

6.1 General

In principle, the Hidropaute ToR describe the impacts to be assessed sufficiently. It is stressed that the potential impacts must be described per alternative considered and must cover the complete affected area. This area may differ per aspect. Negative as well as positive impacts have to be described. Also impacts of the project activities after finalization of the construction phase have to be described.

6.2 Impacts on the natural environment

In addition to the Hidropaute ToR, the EIA-report must specifically describe:

- Changes in river morphology and consequent change of water levels;
- Impacts of noise, vibration and disturbance;
- Impacts on unique or threatened habitats or species;

Not mentioned are the possible impacts of the removal of the water hyacinths. These are present over most of the surface area of the reservoir and removal could have negative impacts on either the air quality or the water quality, depending on the applied method of removal. If the hyacinths are cut and the plant residues are brought ashore in large quantities, the decomposition of the residues may result in bad smells. On the other hand if the plants are chopped and left to sink to the reservoir bottom, this will lead to high carbon loads being deposited onto the sediments. Near bottom oxygen concentrations will reduce significantly as the biomass decomposes. This will lead to mortality of aquatic (in)vertebrates such as fish. Furthermore, the low oxygen levels can cause phosphorous to be released from the sediments via a reduction reaction. This in its turn may fuel a bloom of toxic cyano bacteria, which may pose a risk to aquatic life and water users.

An additional undesired impact of water hyacinth removal can be the proliferation of the pest further downstream.

6.3 Impacts on the socio-economic environment

The EIA-report must describe for the proposed activity:

- Impacts on employment and income, potential for local people to have (temporary) job opportunities (and what kind) in the preparation and execution of the works;
- Hindrance in the area near the dredging works during preparation and execution of the project (noise, smell, vibration, dust) that may cause human and animal health problems and damage to private and public property;
- Increased risk of floods downstream km 30, especially near the village of Mendez.

6.4 Project related risks

The ToR of Hidropaute in its paragraph 'Risks analysis and environmental vulnerability' gives a complete overview of activities to be addressed in the EIA report. Following Ecuadorian requirements, third party liability has to be taken into account as well.

Specific risks to be taken into account are:

- Pollution of the natural environment (eg. oil spills, discharge of untreated waste water and solid waste, including construction waste);
- Impacts of noise, risks (accidents) and pollution on workers and local population;
- Impacts of presence of workers of dredging company on local population.

7. COMPARISON OF IMPLEMENTATION ALTERNATIVES

Environmental and socio-economic impacts of alternatives must be compared, leading to at least the preferred alternative of the proponent and the alternative contributing maximally to sustainability. All alternatives must be compared according to international and commonly accepted standards as much as possible. The comparison must yield the preferred alternative for implementation. For comparison, selection and valuing of alternatives discriminating economic, technical, ecological and social criteria have to be identified.

8. GAPS IN INFORMATION AND KNOWLEDGE

As mentioned in paragraph 4.2.3, the most important gap in knowledge is whether or not, and how, the sediment, once deposited downstream of the Daniel Palacios Dam, will move downstream along the riverbed. A distinction has to be made between the fine sediments (silts and fine sands) and the coarser material. Fine sediments are thought to move gradually downstream along the very steep riverbed as a water sediment mixture. The discharge of the dredge of about 2 m³/sec, seems sufficient to create a continuous downstream flow. However, this flow is probably insufficient to move the coarser

sediments downstream, hence these will accumulate at the pipeline outlet site.

Various options can be identified to prevent accumulation of sediment. These options are either related to flushing the sediment from its deposition site downstream of the dam, or to bringing the sediment to a location where river discharges are such that the river has sufficient sediment transport capacity. In discussing the sediment transport along the riverbed a distinction has to be made between the river stretch between the dam site and km 30, where the river bed is very steep, and the stretch between km 30 and the confluence with the Rio Negro (downstream of Mendez), where the river bed flattens out.

8.1.1 Flushing of the sediment

To flush the coarse sediment from the pipeline outlet site, river discharges just downstream of the dam site have to be increased, either periodically or continuously. A periodic and substantial increase of the discharge is an option, since the transport capacity of running water increases with flow velocity to the power 3 to 5. In other words, if a limited amount of water is available for flushing, flushing with high volumes of water during short periods is more effective than continuous flushing with a small amount. However, both options should be studied.

For the flushing with large amounts of water, use can be made of the 'natural' spilling of the reservoir during the wet season. This could be effective if during the dry season, when no spilling takes place, only fine sediments are discharged, while in the months before the 'natural' spilling period the coarser sediments are dredged and left to accumulate in the river bed, to be flushed with the 'natural' spill. If this 'natural' spill is not sufficient to transport the dredge disposal downstream, additional volumes of water have to be released via the spillway. It has to be taken into account that the 'natural' spilling will be zero, once the Mazar Dam is operational (2009 or 2010).

Note: the fact that spilling will stop after the finalization of the Mazar Dam means that the need to remove the sediments from the riverbed downstream of the dam site is less urgent from that moment on. If no flushing occurs, the risk of large quantities of sediment moving downstream is very limited and the riverbed could probably be used as a permanent storage area for the coarse sediments. This possibility could be studied in more detail.

As a second option, discharge of the sediments with a continuous flow of water should be studied. If this is possible, pre-defined volumes of water could be released from the reservoir continuously, or water for flushing could be diverted or pumped to the pipeline outlet site from elsewhere, e.g. the Rio Negro.

8.1.2 Downstream disposal of the sediments

If a continuous discharge of a certain magnitude is sufficient to remove the sediments, it is also possible to transport the sediments to a location where the River Paute has sufficient sediment transport capacity, by extending the pipelines or constructing a (steep) tunnel. The Rio Negro inflow, at km 5.6 downstream of the dam, is the first location where a substantial discharge enters the riverbed. A next substantial inflow is at the location of the power

house where the water passing the turbines is being discharged to the riverbed.

Once the coarse sediments reach km 30, deposition will occur and a sediment tongue will develop. This tongue will slowly move further downstream and in doing so level out and reduce in height. It is important to know locations and rates of sedimentation and when and in which shape (height) the sediment tongue will reach Mendez, since the corresponding effects on water levels may increase the river bank erosion problems, already now manifest in that area.

8.1.3 Required studies

River hydrodynamics and sediment transport capacities have been studied by the National Centre for Computational Hydroscience and Engineering (NCCHE, 2006). However, this study did not come to decisive conclusions and did not address the above described possible solutions, nor the possible impacts in the Mendez area. It is therefore recommended to do further model studies, the existing NCCHE model could be used for this purpose. Improvements of the model are required, e.g. sediment transport formulae applied for the supercritical flow in the first 30 km downstream of the dam-site should be reviewed and may need to be replaced by more appropriate formulae. To improve model simulations for the situation downstream of km 30, the number of cross sections needs to be increased, preferably at least one cross section per 500 m should be available. Another required improvement is the replacement of the assumed average sediment size by at least two fractions, the fine fraction and the coarse fraction, for which separate model simulations should be made. Furthermore, a number of stage-discharge measurements should be made and sediment samples taken, this to enable (a rough) validation of the model. Model simulations with the improved model of the above described options will shed a light on the viability of the various possibilities and can be used to design mitigating measures to reduce negative impacts.

To assess the sediment discharge capacity of a certain flow, field tests could be applied, e.g. dumping a couple of truckloads of (coarse) sediment in the riverbed downstream of km 5.6 (Rio Negro) and monitor how sediments are transported at a given (measured) discharge. This could give valuable insights in the discharges required to move the sediments downstream.

A final option to reduce downstream sedimentation problems is selective dredging of the fine sediments only, so reducing the amounts of coarse sediments that have to be moved downstream of the dam greatly. Depending on the amounts and locations of fine and coarse sediments in the reservoir, it might be possible to work out a dredging strategy which results in removing 20 million m³ of fine sediments from the reservoir and leaving the coarser sediments to settle at the bottom. It may be worthwhile to study this possibility in more detail. A more detailed 3 dimensional mapping of the composition of the sediment grain size distribution is probably a precondition to make this 'precision dredging' possible.

9. ENVIRONMENTAL MANAGEMENT PLAN

The Hidropaute ToR provides a useful overview of issues to be addressed in the Environmental Management Plan. However, the final content of this EMP should be defined more precisely as a result of the EIA report findings.

10. MONITORING AND EVALUATION

In the EIA report an environmental monitoring plan must be presented, for both the operation phase and long term. This plan must include monitoring of at least:

Physical and environmental aspects:

- Location and rates of sediment accumulation along the Paute River between the Dam and the confluence with the Rio Negro downstream of Mendez;
- Water levels of the Paute River, especially in Mendez;
- Air quality (bad smells, fumes, dust);
- Water quality along the Paute River between the Dam and the confluence with the Rio Negro downstream of Mendez (sediment concentration and grain size distribution).

Socio-economic aspects:

- Fluctuations in population density and migration patterns;
- Employment of available local labour force;
- Presence and variation in agricultural and cattle breeding practices and their effects on natural resources;
- Legal status of land tenure and its effect on conservational practices;
- Presence and effects of mining and (eco)-tourism;
- State of conservation of Sangay national park and protection forests;
- State of conservation of local roads and other services (housing);
- Presence and fluctuation of possibly project related health problems.

The monitoring plan must indicate the institutions responsible for its implementation and the way implementation is funded. It must also include a description of where, how and when (duration and frequency) the monitoring should be conducted.

A project evaluation plan has to be included in the EIA report, indicating which institution will be responsible for evaluation. The main item of evaluation will be to which extent project objectives have been fulfilled.

11. FORMAT AND PRESENTATION OF THE EIA REPORT

It is suggested that the EIA report is written in the same format as this advice for ToR. The use of maps and tables may considerably increase comprehensiveness and is therefore recommended. A non-technical summary must be included. This must address the major subjects of the EIA report and be written in such diction that it provides non-technicians with a clear insight in the issues treated.