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Appendices

1. INTRODUCTION

1.1 The initiative: Realisation of the Stabilized Tidal Inlet project

An ORET grant (Ontwikkelingsrelevante Export Transacties/Export Transactions relevant for Development), requested by the Dutch consulting engineers and architects company (HASKONING), has been approved to support an export transaction. The export transaction involves the design of a so called stabilized tidal inlet in Cartagena, Colombia, and the supervision during its construction. The possibility exists that the execution of works for the tidal inlet will be supported by an ORET grant as well, in case a Dutch contractor obtains the contract for these works. The ORET-desk (DPO/BL) has requested HASKONING to prepare an Environmental Impact Statement (EIS) in support of a decision on the execution of the works. In Colombia, the construction of the stabilized tidal inlet will be the responsibility of the Ministry of Transport, division river infrastructure.

The lagoon 'Ciénaga de la Virgen' is situated near the city of Cartagena (675.000 inhabitants) and covers 22 square kilometres with a volume of 26 million cubic meters. Sewage water and waste are dumped directly into the lagoon. During the last two decades the water quality has deteriorated rapidly. There is no permanent open connection between the Caribbean Sea and the lagoon. The auto-regenerating capacity of the lagoon is limited, causing environmental and health problems.

The National Planning Department in Colombia has established an Integral Sanitation Plan in order to solve the environmental and sanitation problems in Cartagena. One of the components of this plan is the rehabilitation of the lagoon. Two other parts of this plan concern the rehabilitation of the channels and minor lagoons in the surroundings of Cartagena and the Sewerage Masterplan.
This Masterplan consists of the upgrading of the existing sewerage system and the construction of waste water treatment installations.
According to calculations presented by HASKONING, waste water treatment alone will not solve the already existing contamination in the lagoon. The proposed tidal inlet and pertinent structures will allow the 'clean' seawater to mix with the contaminated water of the lagoon. Through dilution and dispersion of the sea water with the polluted water in the lagoon, the contamination can be reduced to an acceptable level of the water quality.
Induced effects expected are a reduction in health problems, improved possibilities for fisheries, a stimulating effect for tourism and increased ground prices.

The project consists of a design and construction phase. The design phase has been completed. The construction phase will take 13 months and consists of the construction of a structure with inlet- and outlet-gates, breakwaters, a guiding dike, pertinent parts, dredging and supervision of the activities.

1.2 Motive for and objectives of this review advice

The Colombian Ministry of Environment has incorporated this project in the Environmental Action Plan for Cartagena 1994-1999. This Ministry carries the responsibility for the control of environmental effects of, amongst others, infrastructural works. For this project, this Ministry will have to grant a permit. In March 1996 HASKONING presented an EIS, based on guidelines of the local authorities.
According to Colombian law, the Terms of Reference (ToR) for an EIS have to be prepared by a local competent authority, in this case the 'Corporación Autónoma Regional del Canal del Dique' (CARDIQUE). In January 1996, the Ministry of Transport has received the ToR for the project involved (see appendix 2).

Dredging and related works are activities which, according to OECD-standards (Organisation for Economic Cooperation and Development) and international loan agreement conditions, are subject to Environmental Impact Assessment (EIA). Objective of the EIA in support of this project is to provide both competent authorities in Colombia and the Netherlands with relevant information on the environmental effects of the activities in order to foster an environmentally-sound, socially acceptable, economically feasible and well-informed decision making process.

In a letter dated 6 March 1996 (see appendix 1), the Netherlands Minister for Development Cooperation has requested the Commission for EIA in the Netherlands (referred to as 'the Commission') to carry out an advisory review of the EIS. The review has been executed in collaboration with CARDIQUE. This joint approach has the support of the Colombian authorities. The joint review is based on the ToR drawn up by CARDIQUE (which are legally binding), supplemented by a review framework of the Commission (appendix 3, see also § 1.3).

The advice has been prepared by a working group of independent members of the Commission in close collaboration with a working group composed by experts of CARDIQUE. The advice will be submitted to the Netherlands Minister for Development Cooperation by the Commission and will be used by CARDIQUE to decide upon a grant for an environmental licence which is required for this project. CARDIQUE is, as mentioned above, the local competent authority which acts on behalf of the Colombian Ministry of Environment.
The composition of these working groups is presented in appendix 4 together with project information.
During the preparation of the advice, the working groups visited the project area, studied the relevant project reports and data and discussed with several governmental and non-governmental authorities and agencies in Bogotá and Cartagena in the period 10-17 June 1996. The programme of the site visit is presented in appendix 5. Purpose of this visit was to collect information on the project enabling formulation of a project- and site- specific review advice of the EIS.

In this advice, the Commission has taken into account as much as possible the opinions of affected people and relevant stakeholders involved.

Herewith, the Commission wishes to express its gratitude for the excellent support and courtesy extended to the Commission by the various organisations in Bogotá and Cartagena during this visit. The Commission would like to express special thanks to the Netherlands Embassy in Bogotá, to HASKONING and to CARDIQUE in Cartagena.

1.3 Justification of the approach

As a first step in the review process, it was agreed that both the Netherlands experts as well as the Colombian experts separately would prepare a preliminary judgement of the EIS, before the actual site visit took place. This preliminary review was executed based on the ToR as established by CARDIQUE.
It was found that, according to standards as used by the Commission for comparable projects, some additional aspects carry significance for the EIS. Therefore, a framework was elaborated in which the ToR were supplemented.
During the site visit a joint review was performed based on the Colombian ToR and on the supplementary ToR as prepared by the Netherlands working group. The findings are presented in chapters 2 and 3.
Appendix 6 presents a copy of the document in which the results of the joint review are ratified by both working groups.

2. REVIEW FINDINGS

The Commission[1]] has the opinion that the EIS, as asked for in the Terms of Reference, is clearly structured and well readable. The Commission was impressed by the information available at the project office and the work carried out by the project team. At the same time the Commission feels that relevant statements need to be more quantitatively supported.
In the opinion of the Commission the EIS has shortcomings on a number of subjects relevant for decision-making. The Commission advices to collect the lacking information and offers to review the supplemented information, once it has become available. It was found that a number of the shortcomings have been dealt with in technical background reports. It is adviced therefore to simply refer to those reports, implying that these reports will be made public. The subjects concerned are described below.

2.1 Problem analysis

The problem analysis does not explicitly describe that the situation after implementation of the works will have improved according to the following criteria:

- standards for water quality set by law (although mentioned in the EIS, these have to be related to the project) ;
- the functions for the lagoon which are planned to be achieved, for the city of Cartagena in general and for the housing areas bordering the Ciénaga de la Virgen in particular (e.g. water quality for fishery purposes or recreational use);
- decrease in diseases related to the contamination of the lagoon (e.g. the infant mortality (currently 40 per 1000) could be used as an indicator).

Although in chapter 2 of the EIS in 'metas del proyecto' some standards are mentioned, the time span in which these standards can be met is not indicated.

In order to be able to come to a more specific description of the objectives of the project, the Commission recommends to state the quantities and qualities (BOD, Kj-N, P-tot, bacteria and suspended solids) of the different discharges into the lagoon. Then it will be possible to determine the extend of the problem and to what extent the pollution figures are out of proportion in comparison to other areas near Cartagena or in comparison to the standards set by law.
The same observation is applicable to a comparison between the present functions and desired functions of the lagoon as well as to the health situation; the existence of health problems should be substantiated by the use of comparative statistics.

2.2 Project setting

An overview is missing of plans and projects which may influence or may be influenced by the construction of the tidal inlet. These plans and projects are the Management Plan for the Cerro de la Popa, the Via Perimetral, the expansion of the Airport Rafael Nuñez and the Sewerage Masterplan.

As the Sewerage Masterplan plays an important role in the assessment of the feasibility of the proposed project, the statement that its execution 'is required', is hardly sufficient. Therefore, according to the Commission, the EIS should elaborate more details of this plan:

- actualized summary of the plans, status, investments required and expected time and guarantees for implementation;
- relationship between Masterplan and tidal inlet project, e.g.:

1 In the following texts, the word 'Commission' should be interpreted as both the Netherlands and the Colombian working group.

- requirements for treatment efficiency when discharged into the lagoon, dependant of the expected use of the lagoon, versus requirements for treatment efficiency when discharged into the sea by a pipeline (scenario 'emisario');
- other boundary conditions for the Masterplan resulting from the project.

! maps indicating the sewerage system and channels, locations of mayor water discharges, rivers, ways and amounts of discharge of not connected habitants (including villages and neighbourhoods around the lagoon) and illegal discharges;

! indication how the discharge of waste water from Cartagena is divided over the surrounding receiving waters, in the current situation and in future scenarios according to the Plan (Bahía, sea, Ciénaga de la Virgen and the smaller lagoons in the city);

! overview of current and future discharges into the lagoon (e.g. from channels and sewers of Cartagena, from rivers and from villages/neighbourhoods and agricultural areas around the Ciénaga de la Virgen): the overview should give data of flows, BOD-load, Kj-N-load, P-tot-load, bacteria and possible toxic compounds;

! information about the possible industrial discharges and specific pollutants from industry (agro-industry in the north-eastern part of the Ciénaga de la Virgen);

! information about disposal of solid wastes and possible discharges of wastes into the lagoon, as well as locations;

! discharges (BOD, Kj-N, P-tot, bacteria and suspended solids) which remain after implementation of the Plan.

Urban spatial planning in relation to the contaminated lagoon has not been considered, because no information is available. However, the present and expected pressure of the population towards the borders of the Ciénaga de la Virgen should be further worked out.

Information has been provided about which organisations (e.g. NGOs and grass roots organizations in the housing areas bordering the Ciénaga de la Virgen) have been involved in the preparation of the EIS. However, it is not clear in what way their opinions influenced the contents of the EIS. Appendix 7 provides information on the social context of the project, which can be of use as supplementary information.

2.3 Alternatives and comparison of alternatives

An overview is missing of possible alternative solutions to improve the auto-regeneration capacity of the lagoon, including a motivation for the selection of the proposed solution. The comparison of the alternatives could be presented in a summary matrix with advantages and disadvantages, including time span and cost of each alternative.
The Commission recommends to provide this information according to the set-up as suggested in the supplementary guidelines, section 'Alternatives' (appendix 3, page iii and iv). Due attention has to be paid to the alternative in which the tidal inlet is constructed, but the treatment plant nor the pipeline will be constructed (alternative 2a). This alternative is very likely, as both projects have not yet been defined.
Another alternative which has been considered, is the possibility of land reclamation of the Ciénaga de la Virgen (complete or partial) in combination with e.g. an inlet structure. The existing land reclamation on the southside of the Ciénaga de la Virgen amounts to approximately 30 meters in a period of 5 years. This process could be transformed into a combined solution of land reclamation where the population and infrastructural pressure is the highest in combination with an inlet structure. Supplemented with a sewerage/-drainage system, the living conditions of the neighbourhoods bordering the lagoon will significantly improve. The opening at La Boquilla is still present. This natural flow offers a possible opportunity to obtain a modified natural inlet and may be sufficient to refresh the remaining northern part in case all loads are diverted/treated.

Finally, the environmentally most friendly implementation-alternative for the construction works is not elaborated.

2.4 Incompleteness of the scope of the project

Part of the project is the construction of outlet gates in the 'Laguna de San Lorenzo' in order to have a flow from the Ciénaga de la Virgen into the caño 'Juan Angola' This part is not clearly described in the EIS and should therefore be added in the description of the alternatives, especially in the selected alternative.

2.5 Modelling

As a substantial part of the EIS is based on the results of modelling studies, the reliability of the models has to be indicated, as well as uncertainties and inaccuracies in the data used and methods of prognostication. The Commission feels that the following water quality and ecological processes should have been studied:

- the effects of nutrient concentrations in the water phase using parameters like potential limiting nutrients, N/P ratios, extinction, occurrence of high phytoplankton and macrophyte biomasses, oxygen-changes;
- the changing redox state of the sediment and possible changes in fluxes of substances;
- the changing nitrification/denitrification fluxes and its consequences for the nitrogen budget;
- the impact of outflowing lagoon water regarding organic and inorganic material, bacterial pollution and nutrients;
- impacts of high loads of macrophytes washed ashore and its possible impact on the functioning of the tidal inlet and accumulation at certain parts of the beach with subsequent degradation;
- the ammonia/ammonium ratio under increasing pH-conditions, indicating whether ammonia levels exceed toxicity thresholds.

The Commission learned however that some of the above processes have already been studied and strongly advices to summarize the quantitative results in the EIS.

2.6 Impacts

- Impact of eutrophication
  The Commission has the opinion that the risk for eutrophication is not addressed adequately. Comparison of nutrient loads with similar water systems with severe eutrophication problems in e.g. the Netherlands, Italy and Tunisia demonstrate extremely high values. Conditions may even become more favourable to algae growth, once the water system will be flushed with clear sea water.
  In order to gain insight into the possible effects of eutrophication, it is necessary to dispose on data of especially algae species composition, biomasses, zooplankton, microfauna and fish associated with mangroves and the lagoon ecosystem.

- Impacts on the marine environment.
  The impacts on the beaches and sea during the construction phase are expected to be negligible, according to the EIS. However, during the operation of the system this might change. Taken into account the projected touristic use of the beaches, the Commission recommends to specify more on expected concentration levels of bacterial contamination, risk for enhanced eutrophication and estimate the aesthetical aspects (colour, smell, litter).

Figure 6.2. presents information about the quality of the marine environment. It is not clear if this represents the impacts in the current situation. The EIS must include calculations on the impacts on the marine environment in all scenarios, analogous to figures 4.9 and 4.10 on the lagoon environment.

! Impacts of the construction of breakwaters
As has been analysed from existing literature, erosion of the shore line at the south-side of the breakwaters will probably take place. This aspect has to be analysed adequately and the measures proposed have to be designed and quantified. These measures must fit within the already existing protection works of the shore line.

! Tidal impacts inside the lagoon
The housing areas at the south side of the lagoon are very vulnerable in relation to the tidal effects and an increase of water level will be very harmful. The calculations which have been used in the EIS need special attention and should be checked.

3. FURTHER OBSERVATIONS

In this paragraph the Commission presents observations on shortcomings of the EIS which are less essential for decision-making on funding of the project. These observations concern methodological aspects, way of presentation and information which should become available later on. The Commission advices to provide this information before and during construction activities. It is suggested to incorporate a number of preconditions on the timely availability of the information in the environmental grant to be prepared. If required, the Commission can assist in reviewing this information.
Again, the Commission found that information on a number of observations is available in documents and appendices at the project office. In that case, these documents can be referred to. A summary of the most important findings and conclusions however, should be stated.

3.1 Study area

The area of the project has been described, mainly towards the terrestrial part. The marine part including its characteristics has only been taken into consideration to a very limited extent.
The natural transports of sediment and its origin have not been described. Cross-sections of the coastal area have not been indicated. The peninsula has been formed from river sediment (Magdalena and of coastal erosion north of the study area). How did this sediment influence the formation of the peninsula and how does the ridge act as a barrier against high tides and storm surges induced by hurricanes? One of the vulnerable areas is located close to 'la punta Zapatero'. The peninsula in some sections is very narrow and the sea could break through temporarily. This situation occurred during the hurricane 'Joan'.
The coast line is very dynamic. The changes can take place in a short period of time. The coast line can be influenced by:

- reduction of sediments of river origin and (protected) coastal sections;
- reduction of sediment due to sedimentation transport towards the sea;
- change of wave flow and possible sea level rise;
- increase of saturation of the coast due to higher water level inside the Ciénaga de la Virgen;
- effects of structures.

These questions need to be addressed to be able to judge the response of the breakwaters.

3.2 Technical description of the project

Most of the points mentioned in the supplementary guidelines (appendix 3, upper half of page iii) concerning the technical description and information related to the design of the construction activities have not been indicated in the EIS or are described in appendices to the EIS. The Commission agrees with the initiator that this kind of information is too specific at this stage of decision-making. Therefore, it is recommended to provide this information in a separate document before construction activities start, paying due attention to the points as mentioned in the guidelines on these items.
The technical description should include the operation of the gates in the structure in relation to the tide and an estimate of the water discharges through the structure during neap tide, average tide and spring tide and the water/sediment budget of the system as a whole. Moreover, the calculation should be included to demonstrate how sedimentation at the inlet of the breakwaters and the structure itself should be prevented.
During the site visit, the Commission learned that HASKONING will prepare an operation and maintenance manual at the start of the construction period. The Commission recommends to include the aspects mentioned above in this manual.

3.3 Other observations

- From the description it is not clear if dredging in the study area will take place and to what extent. The following select items of the dredging process must be evaluated with respect to their impact on the environment: safety, accuracy, selectivity, turbidity, spillage, migration and density. As contamination of this dredged material can be expected, attention should be paid to the safe disposal or the use in the earthwork activities of this material. An analysis of the impacts of the use and disposal of the material must be provided.
- Regarding the presented table on page 29, more information/explanation must be provided, e.g. it should be explained on which assumptions the figures in the table are based. These assumptions and explanations must be related to the actualized data from the Integral Sanitation Plan (see also § 2.2).
- The proposed residence time of approximately 1 week is an average. An elaboration must be given on the distribution of the residence time and the resulting impacts for areas with longer residence times (e.g. stagnant areas nearby the coast line of the lagoon). It is strongly suggested to calculate the age and fractions of different water sources, and a way to do so has been provided.
- It is not clear how the table presented on page 59 corresponds with the data in the table on page 29. The source for the provided data should be explained. Furthermore, it is noted that the load of N is relatively high as compared with BOD.
- The calculations and presentation of BOD concentrations in figure 5.5. give lower results than the measured concentrations on page 60.
- The table on page 65 should be revised for correct standards and units and should include detection limits.
- The EIS does not elaborate on the well functioning of the 'Canal Juan Angola' (will the canal indeed be flushed by one sixth of the total inflowing water through the tidal inlet and will the canal initially be flushed by closing the tidal outlets).
- The EIS does not describe the impact of this flushing on the water quality of the lagoons in the canal system and on 'la Bahía interna de Cartagena' and on the vegetation around the canals and lagoons.
- The EIS does not provide an economic analysis, which would allow the assessment of the effects of the project on the area of influence in terms of change of land-use and increase of property values.

3.4 Monitoring programme

In the monitoring programme only hydrological and water quality parameters of the Ciénaga de la Virgen are mentioned, which unfortunately are not explained in detail. Water and sediment quality at the sea side have to be taken into account as well. Shore erosion and sedimentation have to be included, as well as the installation of new water level gauges. In addition, pollution of the top layer of the sediment and relevant ecological parameters of the lagoon and at the sea side have to be monitored.
The Commission found that HASKONING is preparing a monitoring programme, which will be executed by the contractor under supervision from HASKONING. The Commission recommends to incorporate the aspects mentioned above in this programme.
The responsible authority for the implementation of the monitoring programme has to be indicated, before action starts.

3.5 Presentation of the executive summary

The executive summary is not entirely set up according to the guidelines. Especially the use of maps and tables (as the tables in chapter 7, 'Evaluación
comparativa de alternativas') would have increased comprehensiveness.

3.6 Maps and figures

Maps and figures are not sufficiently detailed and sometimes lacking in the EIS.

- **!** Names of villages, exact location of inlet and structures (in relation to the airport and hotel Las Americas), North direction are sometimes missing.
- **!** Figures and maps which should be provided are:
  - bathymetric maps of the area, including the sea side;
  - map indicating activities and use (lagoon and coastal area);
  - model comparison with water quality standards/objectives (spatial and XY plots for a selected number of locations);
  - scenario-effect per zone (and thus activity and use);
  - cross-section of the housing area at the south side of the lagoon and the related present and future tidal effects.