No.

**Japan International Cooperation Agency (JICA)**
**Ministry of Environment and Water Management, Romania**

# Final Report

# The Study on Protection and Rehabilitation of the Southern Romanian Black Sea Shore in Romania

## Summary

**August 2007**

**ECOH CORPORATION**

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF ENVIRONMENT AND WATER MANAGEMENT, ROMANIA

# FINAL REPORT

## THE STUDY ON
## PROTECTION AND REHABILITATION OF
## THE SOUTHERN ROMANIAN BLACK SEA SHORE IN ROMANIA

# SUMMARY

**AUGUST 2007**

**ECOH CORPORATION**

Exchange rates applied in this Study are:

Part 1 Basic Study and Coastal Protection Plan

| |
|---|
| EURO 1.00 = 3.6 RON<br>(as of October 2005) |

Part 2 Feasibility Study of Coastal Protection and Rehabilitation Project at Mamaia Sud and Eforie Nord

| |
|---|
| EURO 1.00 = 3.5 RON<br>EURO 1.00 = 140 Yen<br>(as of June 2006) |

## FOREWORD

In response to a request made by the Government of Romania, the Government of Japan decided to conduct the Study on Protection and Rehabilitation on the Southern Romanian Black Sea Shore and entrusted the project to the Japan International Cooperation Agency (JICA).

JICA sent to Romania a study team headed by Dr. Yoshimi GODA of ECOH CORPORATION between May 2005 and March 2007.

The team held discussions with the officials concerned of the Government of Romania and conducted field studies in the targeted area in the Study. The team prepared present report upon the final modification.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Romania for their close cooperation extended to the team.

August, 2007

Ariyuki MATSUMOTO
Vice-President
Japan International Cooperation Agency

**LETTER OF TRANSMITTAL**

Mr. Ariyuki MATSUMOTO
Vice President
Japan International Cooperation Agency

Dear Mr. Matsumoto,

It is my great pleasure to submit herewith the Final Report of "the Study on Protection and Rehabilitation of the Southern Romanian Black Sea Shore in Romania".

The study team composed of ECOH CORPORATION conducted surveys in Romania over the period between May 2005 and March 2007 according to the contract with the Japan International Cooperation Agency (JICA).

The study team compiled this report, which proposes an overall coastal protection plan aimed for 2020, and feasibility study on the coastal protection and rehabilitation plan of Mamaia Sud and Eforie Nord, including an operation and management plan, a monitoring plan and an institutional framework, through consultation with officials of the Government of Romania and other authorities concerned.

On behalf of the study team, I would like to express my sincere appreciation to the Government of Romania and other authorities for their diligent cooperation and assistance and for the heartfelt hospitality, which they extended to the study team during our stay in Romania.

I am also very grateful to the Japan International Cooperation Agency, the Ministry of Foreign Affairs of Japan, the Ministry of Land, Infrastructure and Transport of Japan and the Embassy of Japan in Romania for giving us valuable suggestions and assistance during the course of the study

Yours faithfully,

August, 2007

Yoshimi GODA
Team Leader,
The Study on Protection and
Rehabilitation of the Southern Romanian
Black Sea Shore in Romania

## PREFACE

In response to the request of the Government of Romania, the Government of Japan has decided to conduct the Study on Protection and Rehabilitation of the Southern Romanian Black Sea Shore (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for implementation of the technical cooperation program of the Government of Japan, has undertaken the Study in cooperation with the authorities concerned of Romania based on the Scope of the Study agreed upon by the both governments on July 30, 2004, which is attached to the present report in Annex J in Volume 3. JICA awarded ECOH CORPORATION the contract for the execution of the Study in March 2005, and the latter has formed a team of seven experts (hereinafter referred to as "the Team") and dispatched the Team to Romania for six occasions, intermittently since May 2005. The composition of the Team and the information on the Study mission are given in Annex J.

This final report describes the accomplishment of the basic study in the Phase I, the formulation of coastal protection plan in the Phase II, and the feasibility study on the coastal protection and rehabilitation project at Mamaia Sud and Eforie Nord in the Phase II of the Study, which have been executed by the Team during the period of March 2005 to September 2006. The report is comprised of three volumes. Volume 1 presents the main results of the basic study and the coastal protection plan for the whole study area. Volume 2 describes the outcome of the feasibility study on the Mamaia and Eforie Project, while Volume 3 is compilation of Annexes that contain detailed information and data.

Volumes 1 and 2 are provided with their own Executive Summaries for quick references to the contents of the main bodies of the report.

**ACKNOWLEDGMENT**

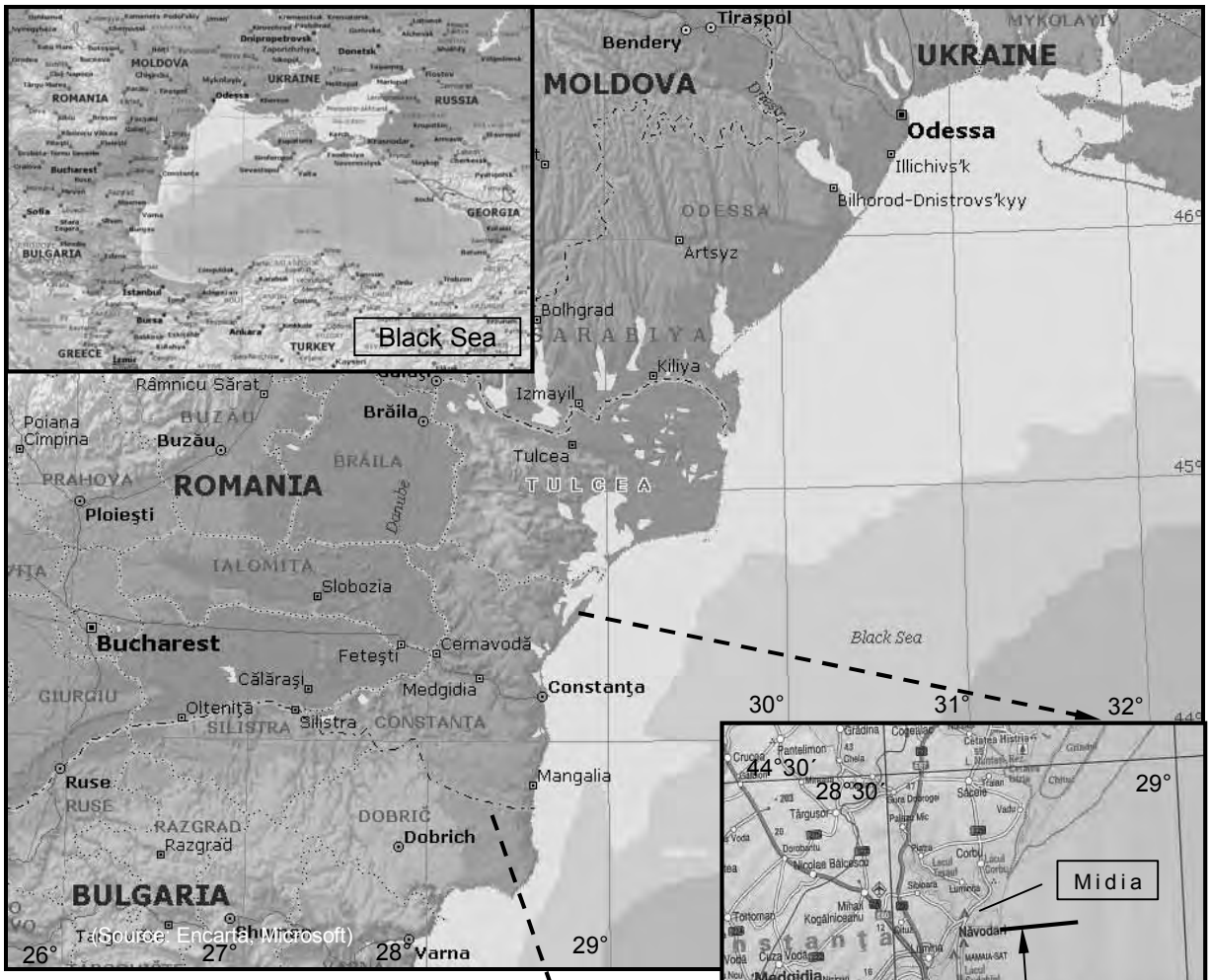
The Study has been made possible through the cooperation and collaboration of many people in Romania. The Team first expresses its sincere thanks to all the Romanian counterparts, the names of which are listed in Annex J.3. They have earnestly assisted the activities of the Team and brought the Study to its completion.

Secondly, the Team acknowledges the excellent works under subcontracts executed by the staff of the National Institute of Marine Geology and Geo-ecology (GeoEcoMar), the National Institute for Marine Research and Development "Grigore Antipa," IPTANA S.A., and INSERT S.R.L., even though the Team refrains itself from listing the names of individual persons involved.

Thirdly, the Team was given invaluable information and data through interviews with the National Agency for Mineral Resources, the River Administration of the Lower Danube Galati, the Administration of Navigable Canal S.H., the National Company Maritime Ports Administration S.A., the Danube Delta Biosphere Reserve Authority, the Delegation of the European Commission in Romania, the Office of the International Bank for Reconstruction and Development, and others.

Last but not least, the Team would like to express its appreciation to Professor Virgil Breaban and his staff at "Ovidius" University of Constanța, who offered the first guidance on coastal problems in Romania in August 2004, assisted the field survey on the willingness-to-pay (WTP), and arranged the use of the university's auditorium for the JICA Symposium in June 2006 and March 2007 in Constanța.

Yoshimi GODA, Prof.
Team Leader of the Study Team

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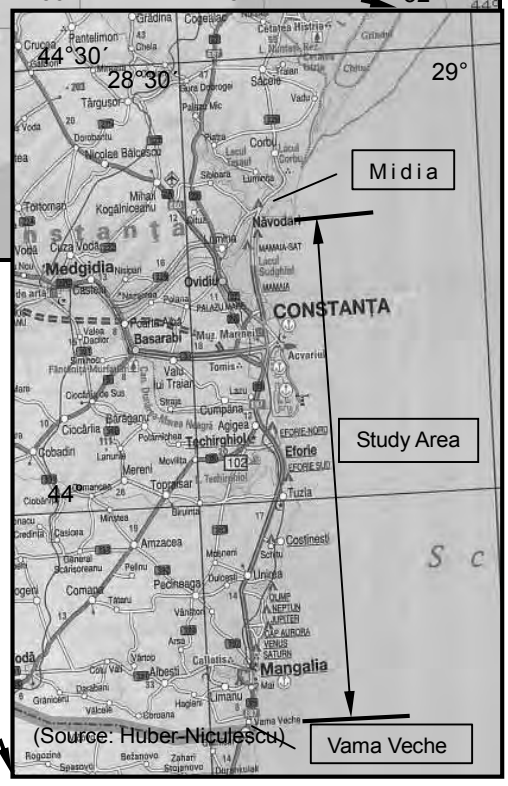
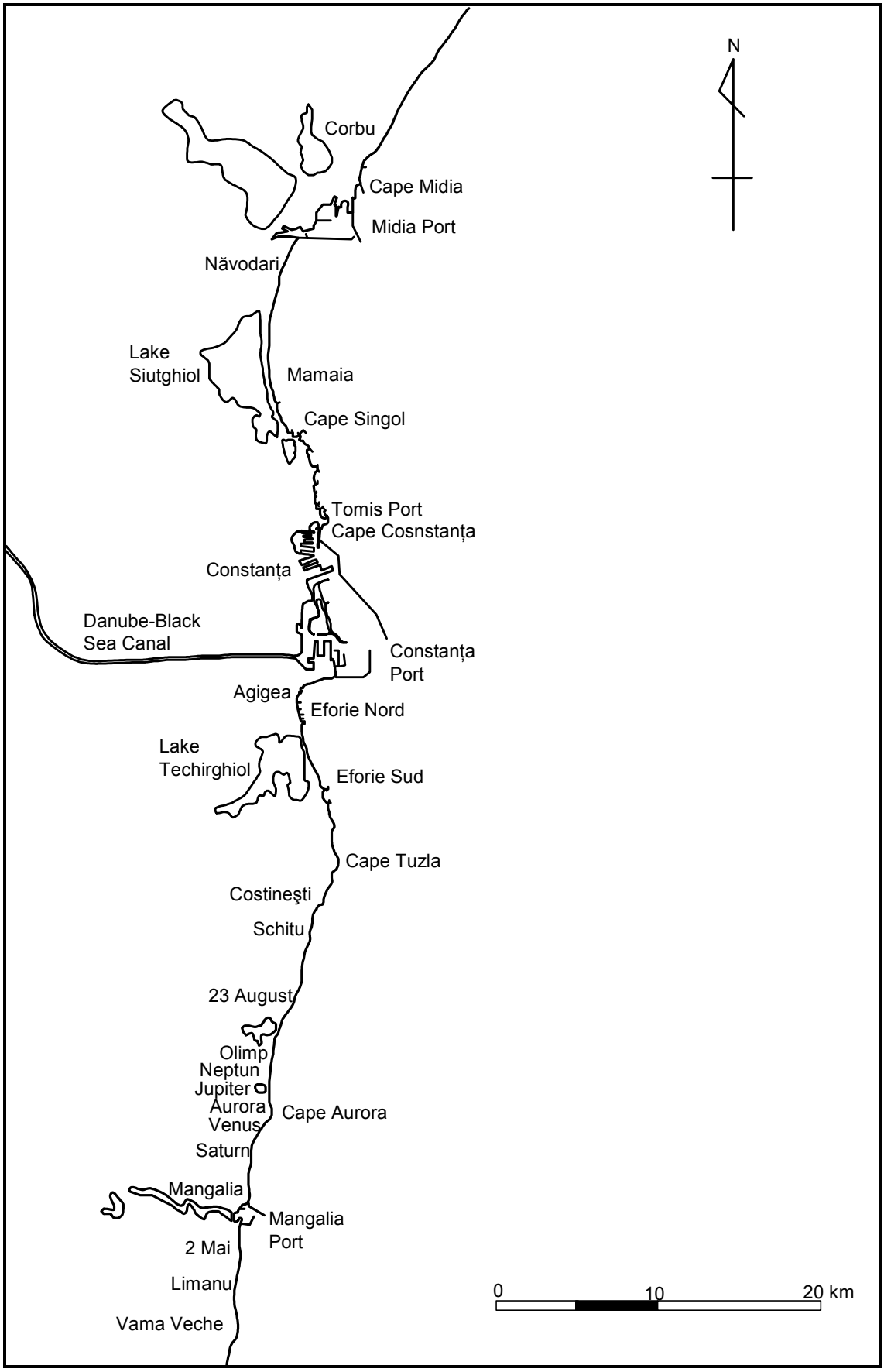



Study Area of Southern Black Sea Shore

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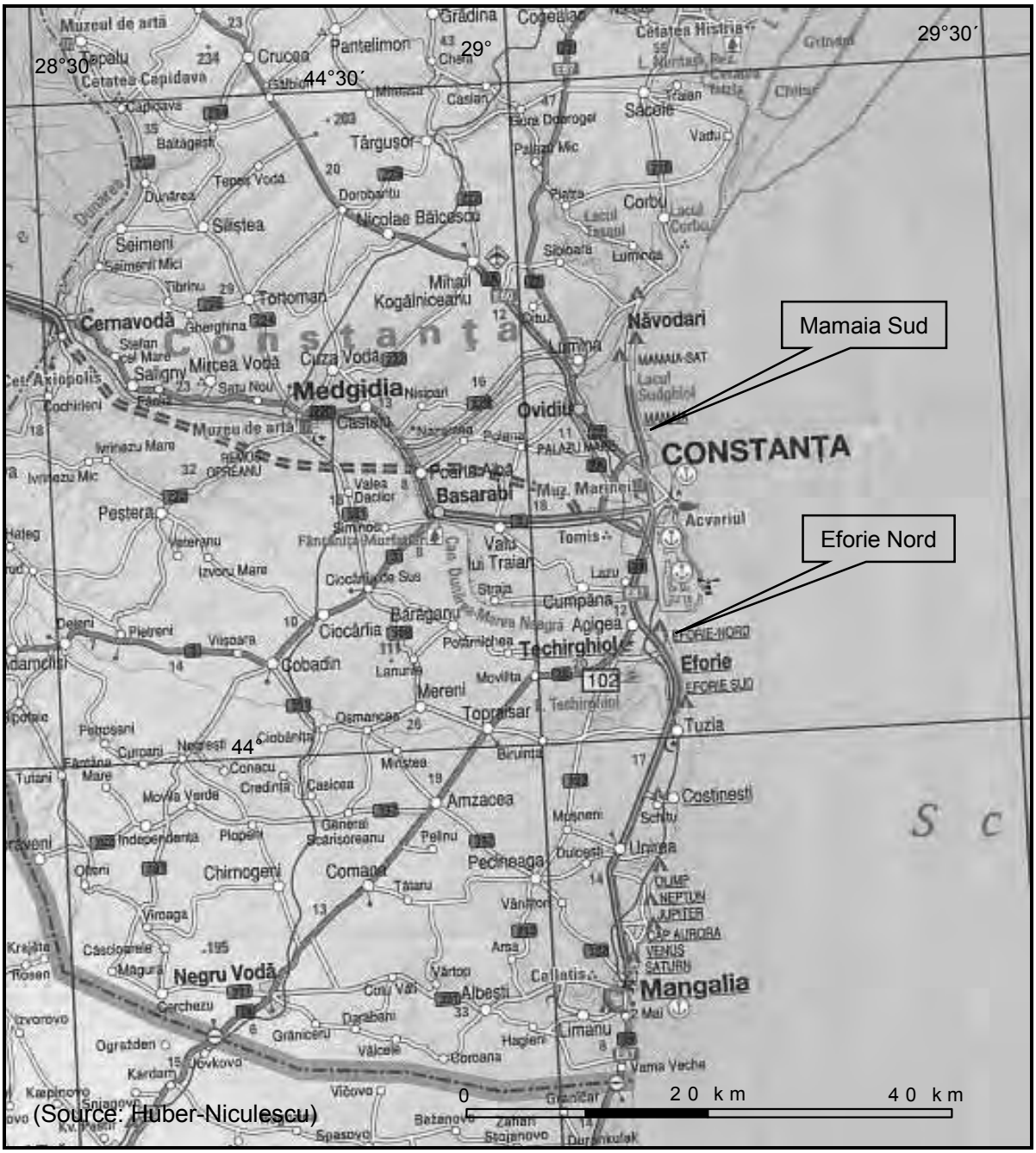


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# ABSTRACT

# ABSTRACT

## A. OUTLINE OF THE STUDY

The Study on Protection and Rehabilitation of the Southern Romanian Black Sea Shore (hereinafter referred to as "the Study") is comprised of three parts, basic study, coastal protection plan, and feasibility study of priority project at two sites. The study area is a stretch of coast extending over some 80 km from Midia to Vama Veche in the Romanian territory, which is located at the northwestern shore of the Black Sea.

The study area has been plagued by severe coastal erosion over years, which threatens the tourism industry in summer season and endangers the safety of housing and public welfare. Upon request of the Government of Romania, the Government of Japan executed a technical cooperation for the Study through the Japan International Cooperation Agency (hereinafter referred as "JICA").

The Study has been carried out for the period of two years from March 2005 to May 2007. The objectives of the Study are to formulate an overall plan for the whole area and to make a preliminary design of coastal protection and rehabilitation project at selected sites. An overall plan for coastal protection and rehabilitation is presented in Volume 1, together with the result of basic study on physical and other related conditions of the study area. A preliminary design of the priority project is presented in Volume 2. Various data and reference materials are compiled in Volume 3 as Annexes.

## B. OUTCOME OF BASIC STUDY

The coastline of the study area includes the areas of sandy beach, cliff coast, and harbors. Excluding the harbor areas of Midia, Constanța, and Mangalia, the beach and cliff extend over 59 km. Most of beaches have been formed in front of lakes or marshes by the natural process of sediment accretion by littoral transport by waves, the rate of which has exceeded the natural erosive force, over many years.

The study area is divided into the northern and southern sub-units with the boundary at Cape Constanța. The beach sand in the northern sub-unit is mainly composed of terrigenous sediment from the Danube having been transported over nearly 200 km. A long extension of the north breakwater of Midia Port since 1977 greatly reduced the supply of littoral sediment transport to Mamaia Beach and has been causing severe beach erosion there. Presently its southern part is being eroded with the rate of 2.0 m per year.

Beaches in the southern sub-unit south of Constanța Port are mainly composed of sand made of bivalve shell fragments. Little trace of terrigenous sand from the Danube is found. Because of few sediment input from the outside, the natural process of gradual coastal erosion is taking place with the average rate of 0.6 m per year.

Physical conditions of wind and wave climate as well as water level have been clarified during the Study. The mean water level at Constanța Port has been rising with the mean rate of 2.2 mm per year for seventy-one years from 1933 to 2004.

A numerical simulation model for the change of shoreline position has been calibrated with the topographic survey data since 1976. The model demonstrated a good reproducibility of the past shoreline changes and promised its reliable capability of predicting the future changes with and without shore protection facilities.

## C. PLAN FOR COASTAL PROTECTION AND REHABILITATION

The study area excluding the harbor areas was divided into seven sectors and twenty sub-sectors. For each sub-sector, alternative plans of coastal protection and rehabilitation including zero-option were examined and the best plan was selected. Among twenty sub-sectors, eight sub-sectors were recognized as requiring project implementation for coastal protection. Twelve sub-sectors were not recommended for projects by the reasons of environmental protection, present stable condition, or low economical feasibility of investment.

The strategy of coastal protection and rehabilitation for the eight sub-sectors has been set as follows:

1) Make large-scale beach fills (nourishment) to solve beach erosion and to create new beach areas;
2) Protect newly nourished beaches with long jetties and offshore submerged breakwaters;
3) Jetties are extended to the depth of 4 to 5 m so that a major part of longshore sediment transport could be confined within the cell between two jetties;
4) Jetties are laid out with wide spacing of several hundred meters so that long beaches are formed and good water circulation would be maintained;
5) Submerged breakwaters are build to restrict the offshore movement of sediment so that the maintenance supply of beach fill sand would be minimized, while maintaining the aesthetic view of the ocean;
6) Deteriorated, detached breakwaters in Mamaia, which have lost their wave damping function owing to settlement of their crown, are rehabilitated with backing of rubble mounds, the tops of which are armored with stabilopods; and
7) Majority of existing groins and submerged breakwater are demolished and removed for safety of beach visitors and aesthetic reasons. The demolished materials are recycled as the core material of new jetties and submerged breakwaters.

With this strategy, the installation plans and cost estimate were made for beach fills, jetties construction, breakwater rehabilitation, submerged breakwater for the eight sub-sectors. The total quantity of various shore protection and rehabilitation facilities and their estimated cost of construction works are listed below.

| | | |
|---|---|---|
| Breakwater rehabilitation: | 1,500 m in total | 15,000 thousand Euro |
| Jetties and groins: | 6,020 m in total | 69,000 thousand Euro |
| Submerged breakwaters: | 4,360 m in total | 69,000 thousand Euro |
| Beach fill: | 3,150,000 $m^3$ in total | 80,000 thousand Euro |
| Removal of existing facilities etc.: | | 13,000 thousand Euro |
| Rehabilitation for Olimp to Mangalia: | | 6,000 thousand Euro |

| | |
|---|---|
| Net construction cost: | 252,000 thousand Euro |
| Total cost of coastal protection plan: | 316,000 thousand Euros |

The above shore protection facilities are to be implemented in two stages over twenty years or more. A cost of 177 million Euros is allocated for the first stage of 15 years, which are further divided into three phases.

## D. PRELIMINARY DESIGN OF PRIORITY PROJECT AT MAMAIA AND EFORIE NORD

Among the eight sub-sectors for project implementation, the sub-sector of Mamaia Sud and a part of the sub-sector Eforie Nord were selected as the priority sites. The two sites are termed as the Component "A" and "B" of the project, respectively. The project with the Components "A" and "B" is scheduled to be implemented in the first phase of the first stage over the period of four years.

The component "A" at Mamaia Sud is planned with the following shore protection facilities:

| | |
|---|---|
| Beach fill: | alongshore distance of 1.2 km, beach width increase of 50 m, sand volume of 224,000 $m^3$. |
| Rehabilitation of two (2) breakwaters: | length of 250 m each. |
| Construction of one (1) sand retaining jetty: | length of 200 m. |
| Construction of three (3) submerged groins: | length of 100 m each. |

The component "B" at Eforie Nord is planned with the following shore protection facilities:

| | |
|---|---|
| Beach fill: | alongshore distance of 1.2 km, beach width increase of 80 m, sand volume of 467,000 $m^3$. |
| Rehabilitation and extension of one existing jetty: | extension length of 60 m. |
| Rehabilitation of one existing jetty: | length of 180 m. |
| Construction of three (3) submerged breakwaters: | lengths of 200m, 200m and 275 m. |

The total cost of the project is estimated as 40.25 million Euros, of which 11.54 million Euros is allocated for Mamaia Sud and 28.71 million Euros for Eforie Nord.

The benefit of the project has been measured with the estimate of the willing-to-pay by citizens and tourists for the presence of beaches, the foreign exchange earned from expatriate tourists to the region in association with the incremental beach areas, foreign exchange saved due to the prevention of the downsizing expatriate tourism to the region associated with beach preservation, and social costs saved. The economical internal rate of return has turned out to be 9.7%.

Recommendations have been made for the operational framework including the project implementation unit and the environmental and physical monitoring programs.

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| | | |
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| A | AFDJG: | River Administration of the Lower Danube, Galati |
| | AIS: | Agreement of Subsidiary Loan |
| | ANAR: | National Administration of Romanian Waters “Apele Romane” |
| | AR: | Artificial Reefs |
| C | C/B: | Cost-Benefit |
| | CAS: | Country Assistance Strategy |
| | CBA: | Cost Benefit Analysis |
| | CBC: | Cross Border Cooperation |
| | CEB: | Council of Europe Development Bank |
| | CET: | Heating Power-Station |
| | CF: | Cohesion Fund |
| | CFCU: | Central Financial and Control Unit |
| | CIF: | Cost, Insurance and Freight |
| | CIGCCE: | Committee for Guarantees and Credits for External Trade |
| | CNP : | National Commission of Forecast |
| | COA : | Romanian Court of Accounts |
| | CPS: | Country Partnership Strategy |
| | CQ: | Consultant's Qualification |
| | CRF: | Capital Recovery Factor |
| | CVM: | Contingency Valuation Method |
| | CVM: | Contingent Valuation Method |
| D | DADL: | “Apele Romane”, Water Directorate Dobrogea - Litoral |
| | DC: | Direct Contracting |
| | DFI: | Direct Foreign Investment |
| | DFID: | Department for International Development |
| | DL: | Datum Level |
| | DR: | Development Regions |
| | DSCR: | Debt-service Coverage Ratio |
| E | EBRD: | European Bank for Reconstruction and Development |
| | EC: | European Council |
| | ECMWF: | European Centre for Medium Range Forecasting |
| | EEC: | European Economic Community |
| | EFN: | Eforie Nord |
| | EGO: | Emergency Governmental Ordinance |
| | EIA: | Environment Impact Assessment |
| | EIB: | European Investment Bank |
| | EIRR: | Economic Internal Rate of Return |
| | EMP: | Environmental Management Plan |
| | ENPV: | Economic Net Present Value |
| | EPA: | Environmental Protection Agency |
| | EPAC: | Environment Protection Agency, Constanța |
| | EPI: | Environmental Protection Inspectorates |
| | ERDF: | European Regional Development Fund |
| | ESF: | European Social Fund |
| | ESOP: | Environmental Sectoral Operational Program |
| | EU: | European Union |
| F | FB: | Final Beneficiary |
| | FIRR: | Financial Internal Rate of Return |
| | FOB: | Free on Board |
| | FX: | Foreign Exchange |
| G | GD: | Government Decision |
| | GDP: | Gross Domestic Product |

GDRP: Gross Domestic Regional Product
GEF: Global Environment Facility
GeoEcoMar: National Institute of Geology and Geo-ecology
GOR: Government of Romania

H
HC: Hydrocarbons
HRMEP: Hazard Risk Mitigation and Emergency Preparedness Project
HWL: High Water Level

I
IBRD: International Bank for Reconstruction and Development
ICB: International Competitive Bidding
ICCE: International Conference on Coastal Engineering
ICZM : Integrated Coastal Zone Management
IDA: International Development Association
IFC: International Financing Corporation
IFI: International Financing Institutions
IMF: International Monetary Fund
IPCC : Intergovernmental Panel on Climate Change
IPPC: Integrated Pollution Prevention and Control
IRR: Internal Rate of Return
ISPA: Instrument for Structural Policies for Pre-Accession

J
JBIC: Japan Bank for International Cooperation
JICA : Japan International Cooperation Agency

L
L/A: Loan Agreement
LAPEP: Local Action Plan for Environmental Protection
LCP: Large Combustion Plants
LCS: Term of Low Crested Structure
LCS: Least Cost Selection
LEP: Local Environmental Policy
LEPA: Local Environment Protection Agency
LRMC: Long-run Marginal Cost
LWL: Mean Monthly Lowest Water Level

M
M/E: Monitoring and Evaluation
MAFRD: Ministry of Agriculture, Forests and Rural Development
MAI: Ministry of Administration and Interior
MDS: Multivariate Statistics Methods - Multidimensional Scaling
MIG: minimum income guarantee
MIR: Minimum Ratio of Residual Correlation Coefficient
MIU: Management and Implementation Unit
MOC: Marginal Opportunity Cost
MoEWM: Ministry of Environment and Water Management
MoHF: Ministry of Health and Family
MoPA: Ministry of Public Administration
MoPF: Ministry of Public Finance
MoTCT: Ministry of Transport, Construction and Tourism
MTEF: Medium-tern Expenditure Framework
MWL: Mean Water Level

N
NAMR: National Agency for Mineral Resources
NAPEP: National Action Plan for Environmental Protection
NATO: North Atlantic Treaty Organization
NB: Net Benefit
NBR: National Bank of Romania
NCB: National Competitive Bidding
NCCZ: National Committee of the Coastal Zone
NDP: Romanian National Development Plan
NEAP: Romanian National Environment Action Plan
NEG: National Environmental Guard

| | | |
|---|---|---|
| | NEP: | Romanian National Environmental Policy |
| | NEPA | National Environmental Protection Agency |
| | NGO: | Non-governmental Organization |
| | NIMRD: | National Institute for Marine Research and Development "Grigore Antipa." |
| | NPV: | Net Present Value |
| | NSEP: | National Strategy for Environmental Protection |
| | NSRF: | Develop Basic Infrastructure to European Standards |
| O | OM: | Operation and Maintenance |
| P | PAH: | Polycyclical Aromatic Hydrocarbons |
| | PAL: | Programmatic Adjustment Loan |
| | PCC: | Project Coordination Committee |
| | PCO: | Primary Credit Orderers |
| | PFM: | Public Financial Management |
| | PIU : | Project Implementation Unit |
| | PMU: | Project Management Unit |
| | POP: | PAH and Organochlorine Pesticides |
| | POT: | Peaks-over-Threshold |
| | PSC: | Project Steering Committee |
| | PYG: | Pay-as-you-go |
| Q | QC: | Consultant Qualification |
| | QCBS: | Quality and Cost-based Selection |
| R | Raja: | Water Company |
| | REPA: | Regional Environment Protection Agency |
| | RkD: | Rank of Species |
| | RMA: | Romanian Meteorological Administration |
| S | SA: | Special Account |
| | SAPARD: | Special Action Program for Agricultural and Rural Development |
| | SC: | Steering Committee |
| | SCF: | Standard Conversion Factors |
| | SDR: | Social Discount Rate |
| | SEA: | Strategic Environmental Assessment |
| | SME: | Small and Medium Scale Enterprises |
| | SOP: | Sectoral Operational Program |
| | SRMOC: | Short-run Marginal (Opportunity) Cost |
| T | TA: | Technical Assistance |
| | TAC : | Total Admissible Captures |
| | TC: | Total Cost |
| | TOR: | Terms of Reference |
| | TPH: | Total Petroleum Hydrocarbons |
| | TR: | Total Revenue |
| | TRC: | Technical Review Committee |
| U | UGO: | Urgent Government Ordinance |
| | UNCED: | United Nations Conference on Environment and Development |
| | USAID: | United States Agency for International Development |
| V | VAT: | Value Added Tax |
| | VOC: | Volatile Organic Compound |
| W | WB: | World Bank |
| | WD: | Significance Index |
| | WFD: | EU Water Framework Directive |
| | WFD: | Water Framework Directive |
| | WTP: | Willingness to Pay |

# PART 1

## BASIC STUDY AND COASTAL PROTECTION PLAN

# PART 1 BASIC STUDY AND COASTAL PROTECTION PLAN

## 1.1 Background of Project for Coastal Protection Planning

Romania has a territorial coastline extending over 240 km along the northwestern side of the Black Sea. In the past several decades, however, the Romanian Black Sea shore has been suffering from serious beach erosion problems. The northern unit of the Romanian coastal area, which is designated as the Danube Delta Biosphere Reservation, is most affected, but its southern unit is also in danger where the economical activity is strong, including the tourism industry which attracts some 800 thousands check-in tourists every year.

The coastal erosion not only threatens the tourism industry in summer season through the loss of beach area but also endangers the safety of housing and public welfare. New projects for the protection and rehabilitation of the southern Romanian Black Sea shore are urgently needed. Upon the request of the Government of Romania, the Government of Japan decided to make a technical cooperation for the Study on Protection and Rehabilitation of the Southern Romanian Black Sea Shore (hereinafter referred to as "the Study") through the Japan International Cooperation Agency (hereinafter referred to as "JICA"). Although several cliff failures in the study area have caused damage to local communities, it was excluded from the Scope of Work after the discussion between representatives of the Government of Romania and JICA.

The Study was undertaken since March 2005 by a team of experts entrusted by JICA and was concluded in August 2007 by submission of the Final Report. The Final Report, which comprises three volumes, summarizes the outcome of the Study. The Volume 1 mainly discusses the results of the basic study and the formulation of the coastal protection plan for the Southern Romanian Black Sea shore. Volume 2 presents the output of the feasibility study on the priority projects, and Volume 3 lists twelve annexes which contain various data and information related to the Study.

## 1.2 Objectives of Coastal Protection Planning

The project for the protection and rehabilitation of the southern Romanian Black Sea shore aims at stopping the coastal erosion and increasing the asset value of coastal zone with creation of new beach areas. The Study by JICA has the objectives of formulating a coastal protection plan aimed at the year 2020 and making a preliminary design on priority projects so that the Government of Romania will be able to implement the coastal protection project with appropriate funding.

The coastal protection plan is to provide a long-term strategy for protection and rehabilitation of the southern Romanian Black Sea shore. Analysis is made of the physical conditions in the Study area that extends from Cape Midia to Vama Veche (hereinafter referred to as "the Study area"), inclusive of the state of beach erosion and it mechanism, for rational planning of coastal protection measures. Based on the following four criteria; 1)urgency of coastal protection, 2)beach utilization, 3)economical feasibility of project implementation, 4)needs for promotion of regional development, a time schedule of project implementation in various sectors is proposed. Selection is made for the areas that are provided with the earliest project

implementation, i.e. priority projects.

## 1.3 Social and Economic Background

Romania has a democratic republic government and became a member state of the European Union in January 2007. Its population is 21.7 million with the average life expectancy of 72 years. The Gross Domestic Products (GDP) per capita stood at US$3,240 in 2004. The average monthly net earnings per household are estimated as US$211 in 2004.

The Study area is located in Constanța County. Its population is 714 thousands, among which Municipality of Constanța has the largest share of 307 thousands. Major economic activities in Constanța County are industries, agriculture, transport etc. However, tourism in the summer season is also strong with the registered stay-in visitors of 755 thousands in 2004, of which 84 thousands came from foreign countries. The number of tourists is growing up since the lowest of 659 thousands in 2001.

## 1.4 Physical Conditions of the Study Area

### 1.4.1 Geological and Geomorphological Features

The Study area is divided into the northern sub-unit and the southern sub-unit with the boundary at Cape Constanța. The beaches in the northern sub-unit are mainly composed of terrigeneous fine sand supplied by the Danube, having been transported over 200 km by wave-induced longshore currents. Shell fragments are the secondary source of beach sand. A 13-km long barrier beach of Navodari and Mamaia is present between Cape Midia and Cape Singol. Further south between Cape Singol and Cape Constanța the coast is made of narrow beaches and low cliffs, some of which are in dangerous state of collapse induced by water saturation in the soil by heavy rain etc. Figure 1.1 shows the geomorphological map of the Study area in the north of Tuzla Cape.

The southern sub-unit between Cape Constanța and Vama Veche is essentially a cliff coast with several barrier beaches in front of seaside lakes, which were land-locked by alongshore transport of sediment in the past. Beach sand is made of shell fragments supplemented by fragments of limestone at the base of cliffs. No trace of terrigeneous sand from the Danube is found in the southern sub-unit.

### 1.4.2 Wind and Wave Conditions

Winds mainly blow from the northern sector in winter and from the southern sector in summer, but they are not consistent in the direction. The mean wind speed in Constanța is about 5 m/s, while the 90% and 99% non-exceedance speed are about 10 and 15 m/s, respectively. Figure 1.2 shows the wind rose at the offshore of Constanonța Port based on the data from the European Center for Medium Range Weather Forecasting (ECMWF).

Waves follow the wind direction, but large waves mainly come from the northeastern sector with the secondary sector of the southeast. Waves were analyzed with the two data sets: visual observations with a special set of binoculars at the depth of 11 m (three times a day from 1996 to 2002) and the wave hindcast data off Constanța Port by ECMWF from 1991 to 2002. Figure 1.3 shows the non-exceedance probability of significant wave height. Open circles indicate the visual data by NIMRD, while closed circles are the ECMWF data; they yield

almost the same probability. Figure 1.4 is the histograms of significant wave period, in which the visual data yields a slightly short period. Figure 1.5 exhibits the histograms of wave direction, in which the visual data are concentrated in a narrow range due to wave refraction.

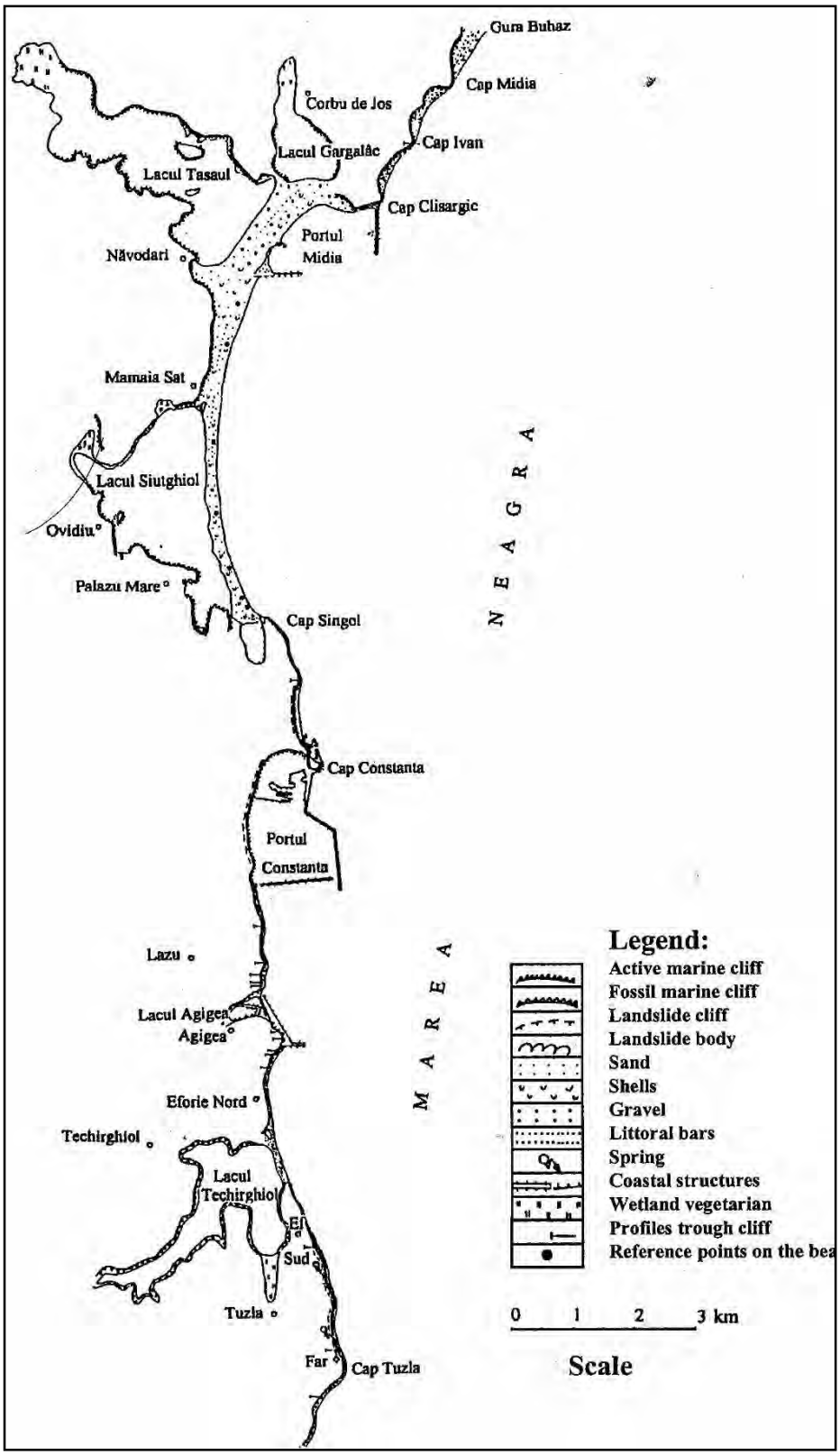


Fig. 1.1: Geomorphological map of Southern Romanian Black Sea Coast (Cape Midia – Cape Tuzla) around 1970 (source: GeoEcoMar 2005)

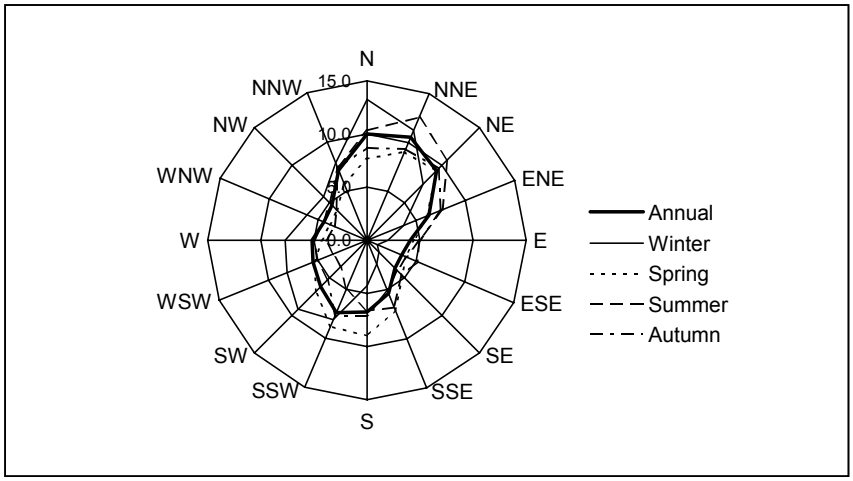


Fig. 1.2: Directional distribution of wind frequency (in percentage) in Black Sea off Constanța

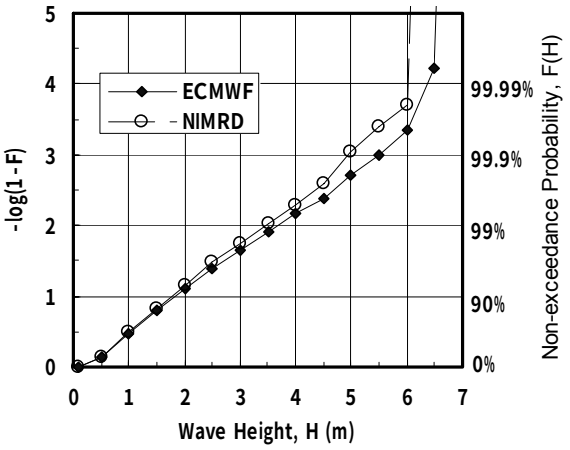


Fig. 1.3: Cumulative distribution of significant wave height

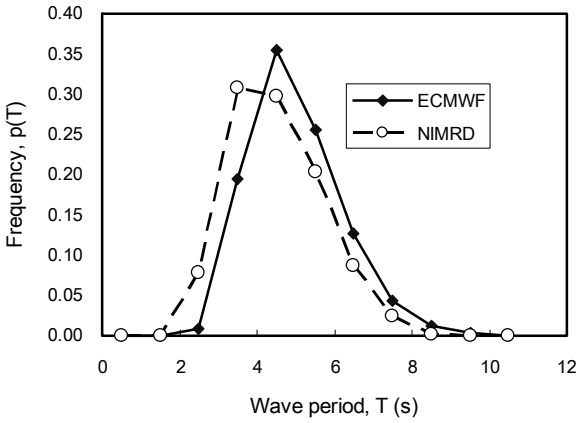


Fig. 1.4: Histograms of significant wave period

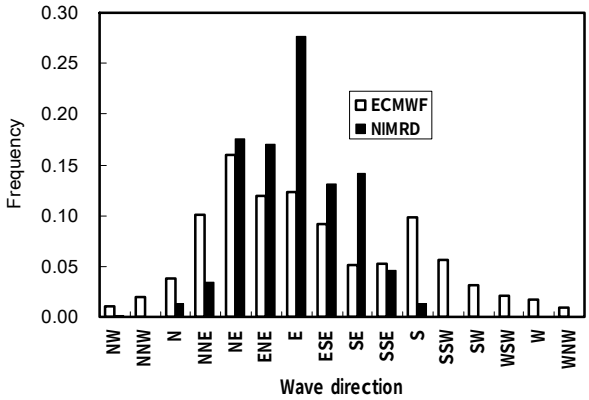


Fig. 1.5: Histograms of wave direction

The waves with the return period of 100 years are estimated as 7.8 m in height and 11.0 s in period. The values refer to those of the significant waves, the height of which is defined as the average of the highest one-third waves. The single highest wave in 100 years may go up to 14 m.

Waves are highest in December and January, while they are lowest in June and July. The mean height of the significant waves during winter is 1.2 m, while it is 0.8 m in summer. The energy averaged waves, which are used for sediment transport computation, is 1.65 m in height and 6.2 s in period from the azimuth N64ºE, and 1.11 m in height and 6.2 s in period from the azimuth N115ºE. The 90% and 99% non-exceedance significant wave height are 1.8 m and 3.6 m, respectively.

### 1.4.3 Tide and Water Level

The astronomical tide is very small. The spring tidal range (twice the sum of the amplitudes of principal lunar and solar semidiurnal components) is 4.0 cm in Constanța and 5.1 cm in Mangalia. However, the mean water level fluctuates widely: the highest and lowest water levels (daily mean) ever recorded in Constanța are 0.90 m and –0.30 m, respectively. The mean monthly highest water level (HWL) is 0.38 m, while the mean monthly lowest water level (LWL) is 0.13 m. The causes of large fluctuation of mean water level are unknown.

The annual mean water level in Constanța has steadily rising since the start of the water level observation in 1933 with the mean rate of 2.2 mm/year, which is much larger than those at the stations along the oceans. This rate of the mean water level rise is equivalent to the shoreline retreat rate of –0.18 m/year at Mamaia and –0.08 m/year at Costineşti.

### 1.4.4 Beach Erosion and Its Mechanism

The rate of the shoreline position change has been analyzed from the shoreline survey data by the National Institute for Marine Research and Development “Grigore Antipa” and various topographic maps in the past. Figure 1.6 shows the result of shoreline change analysis for the whole baselines; the benchmarks in this figure are those in the sub-sectors of Năvodari and Mamaia only. The abbreviations of EF, CN, NN, and VV (the lowest) refer to Eforie, Costineşti, Neptune, and Vama Veche, respectively. Examples of the shoreline change rate (average of respective area) are listed below; a negative value indicates erosion.

| | |
|---|---|
| Mamaia North | –0.4 m/year |
| Mamaia South | –2.0 m/year |
| Tomis | –0.2 m/year |
| Eforie Middle | –0.7 m/year |
| Eforie Sud | –0.6 m/year |
| Tuzla | –0.7 m/year |
| Costineşti | ±0.0 m/year |
| Olimp – Venus | –0.5 m/year |
| Saturn – Mangalia | –0.8 m/year |
| 2 Mai | –0.6 m/year |
| Vama Veche | –0.7 m/year |

The severest erosion is taking place in the southern part of Mamaia, where the shoreline will retreat more than 40 m in the coming twenty years if no countermeasures are undertaken.

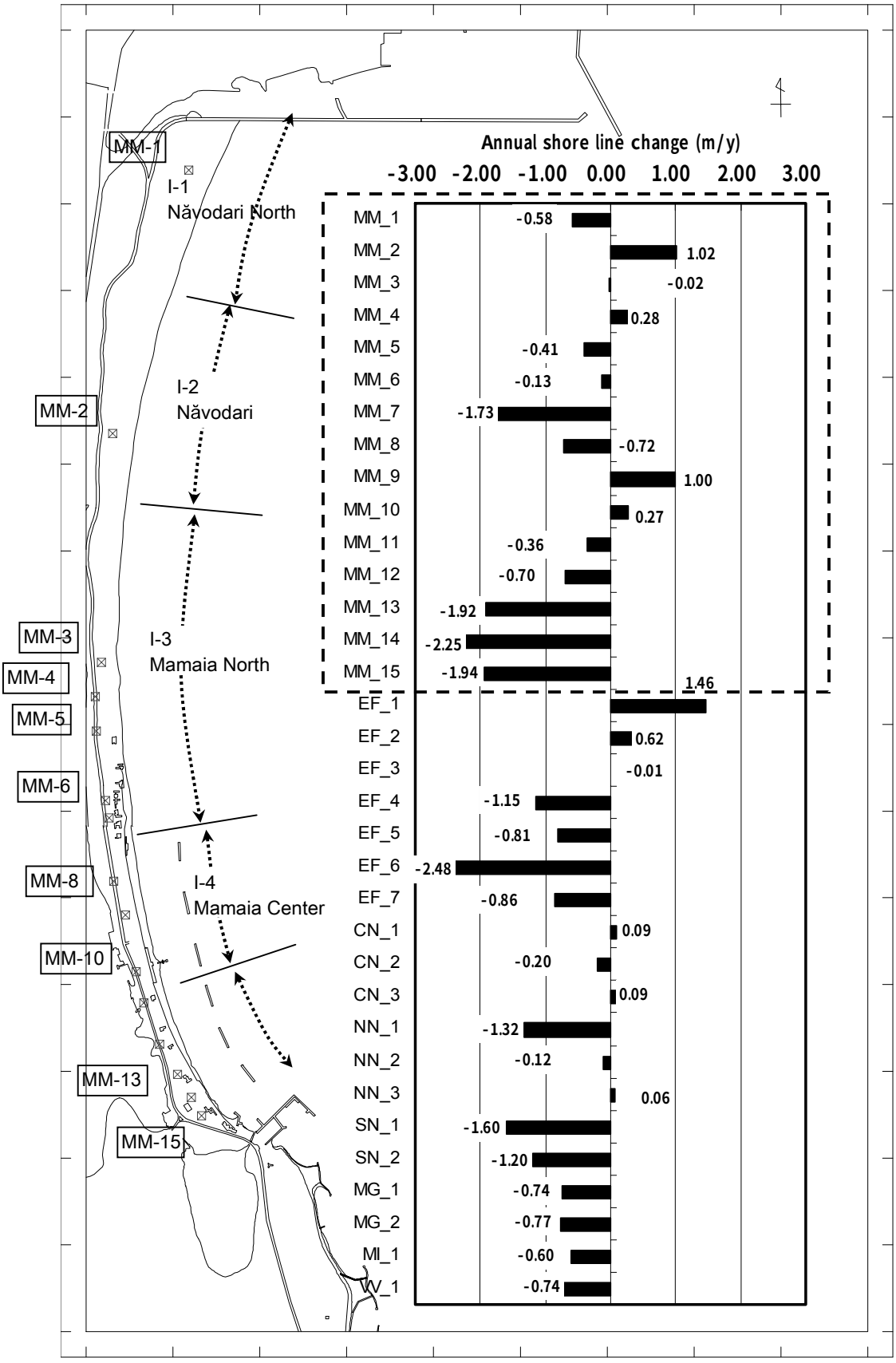


Fig. 1.6: Rate of shoreline position changes based on beach profile survey data

The mechanism of beach erosion differs in the northern and southern sub-units of the southern Romanian Black Sea shore. The major cause of beach erosion in the northern sub-unit is the impoundment of terrigenous sand by the north breakwater of Midia Port, which was extended to the depth of –10 m since 1977. Sand transported southwestward by wave-induced longshore currents was stopped at the breakwater and could not move further toward Navodari and Mamaia. Decrease of the sediment discharge of the Danube contributed to deficiency of sediment supply to the northern sub-unit. Along the long beach of Mamaia, the alongshore sediment transport by waves is estimated as 160,000 $m^3$/year northward and 140,000 $m^3$/year southward, which results in the net northward transport rate of about 20,000 $m^3$/year. This net transport of sediment without new supply is the reason of intensive beach erosion at the south of Mamaia. Sediment transported northward is eventually carried away by the cross-shore currents offshore and lost from the shore area.

The coastal erosion in the southern sub-unit is not as severe as that in Mamaia, except for the area of Balta Mangalia and the soft cliff area of Limanu. Most of the cliff coasts are receding with the rate of about 0.6 m/year for many years, which seem to be the natural process of this sub-unit. With recess of cliff lines, adjacent beaches have to retreat, which is beach erosion. Imbalance between the northward and southward sediment transport also causes local beach erosion, and there is a cross-shore loss of sediment.

### 1.4.5 Shoreline Changes and Their Prediction

Topographic survey data of the shoreline positions available since 1976 were analyzed and employed for the calibration of the numerical model based on the one-line theory. With the proper selection of the northerly and southerly representative waves, sediment transport coefficients, and other relevant factors, the numerical model succeeded in reproducing the advances and retreats of the shoreline in the area of Năvodari to Tomis and that of Eforie.

The validated numerical model was used for the prediction of the future changes of shoreline position in 20 years without any protective measures. It was also utilized to evaluate the effectiveness of the proposed shore protection and rehabilitation plan. The model assisted the formulation of priority project with the prediction of a minimum amount of refilling of sand on the nourished beach, though there remains a possibility of unexpected needs for maintenance supply of beach fill owing to occurrence of exceptional storm waves.

The so-called 3-D model was not employed in the present study because of no availability of detailed bathymetric data in the past, which is the prerequisite for validation of any 3-D model. The numerical model employed in the present study does not predict any change in sea cliff. It is mentioned that the model has been applied by assuming extension of beaches in the position of sea cliff.

## 1.5. Outline of Coastal Protection Plan

### 1.5.1 Sectors and Sub-sectors of the Study Area

The Study area from Midia to Vama Veche, which is the southern unit of the Romanian Black Sea shore, is divided into seven sectors and twenty sub-sectors as shown in Fig. I.1 for convenience of executing the Study. Seven sectors are regarded as independent coastal littoral cells, which are as the boundaries defined by littoral processes and zones of sediment

convergence and divergence. Thus, measures taken within a specific sediment cell may affect the shore process of the same cell, but they will not impact on adjacent cells. The Constanţa Sector has two independent cells divided at Cape Singol, and the Mangalia Sector also has two independent cells divided at Cape Aurora. Thus, there are nine independent coastal littoral cells within the Study area.

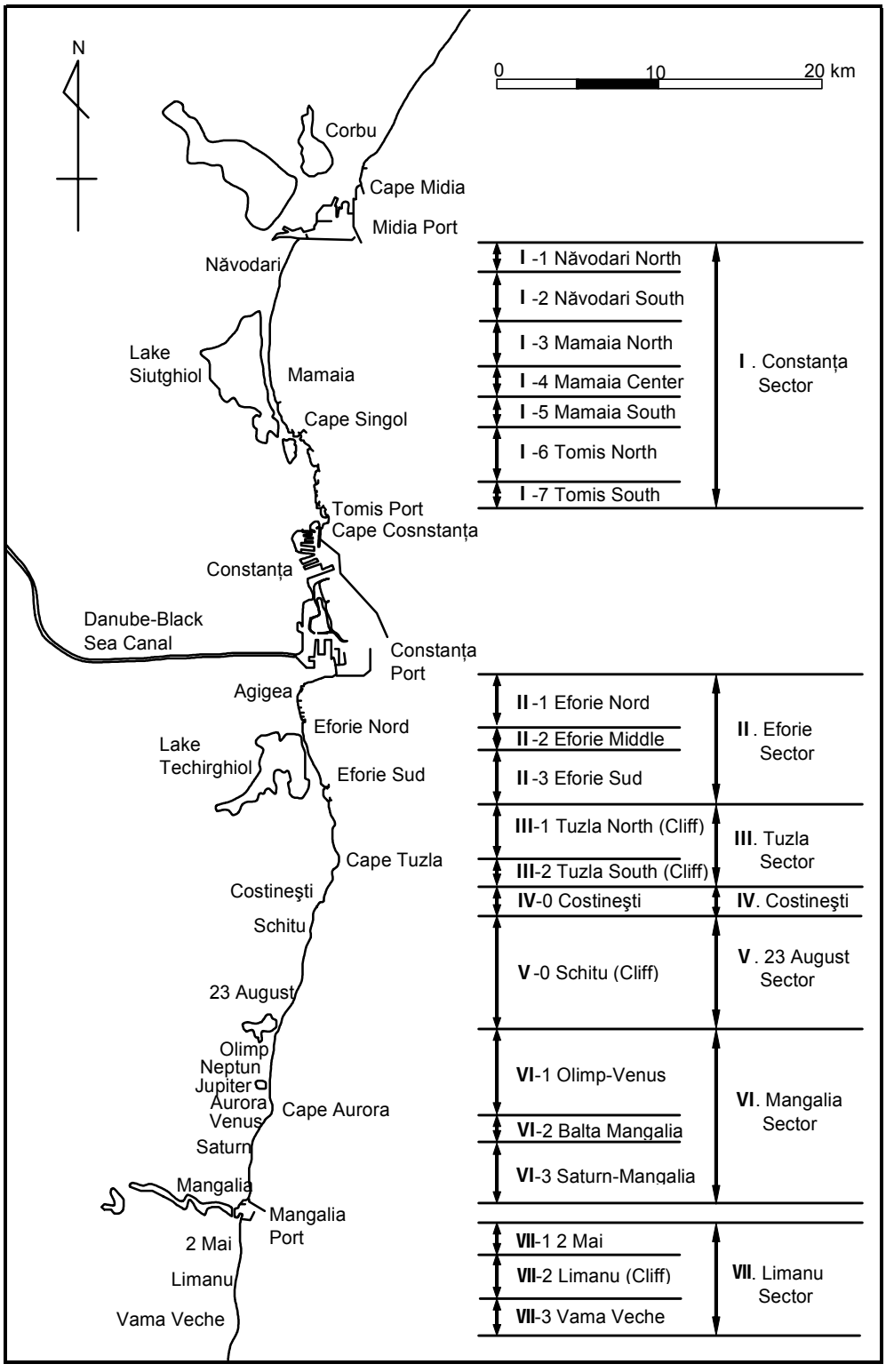


Fig. 1.7: Map of sector and sub-sector division of the study area

### 1.5.2 Strategy of Coastal Protection and Rehabilitation

The shoreline of the Study area has been provided with various protective facilities such as seawalls, groins, and detached breakwaters. There were occasional beach fill (nourishment) operations such as that carried out in Mamaia in 1989. However, the majority of existing protective facilities have been deteriorated and not functioning properly. Most of groins are too short and were laid out in close proximity, creating narrow water areas and short beaches. Poor state of water circulation and exchange in these narrow water areas has contributed to the water pollution problems along the beach, even though the culprit is eutrophication owing to insufficient treatment of waste water from hotels and residential areas.

The strategy to remedy the problems of beach erosion and water pollution is as follows:

1) Make large-scale beach fills (nourishment) to solve beach erosion and to create new beach areas;
2) Protect newly nourished beaches with long jetties and offshore submerged breakwaters;
3) Jetties are extended to the depth of 4 to 5 m so that a major part of longshore sediment transport could be confined within the cell between two jetties;
4) Jetties are laid out with wide spacing of several hundred meters so that long beaches are formed and good water circulation would be maintained;
5) Submerged breakwaters are build to restrict the offshore movement of sediment so that the maintenance supply of beach fill sand would be minimized, while maintaining the aesthetic view of the ocean;
6) Deteriorated, detached breakwaters in Mamaia, which have lost their wave damping function owing to settlement of their crown, are rehabilitated with backing of rubble mounds, the tops of which are armored with stabilopods; and
7) Majority of existing groins and submerged breakwater are demolished and removed for safety of beach visitors and aesthetic reasons. The demolished materials are recycled as the core material of new jetties and submerged breakwaters.

### 1.5.3 Scope of Coastal Protection Plan

The Study area is composed of nine coastal littoral cells, which individually respond to waves, currents and other natural environments without being affected by neighboring coastal littoral cells. Because of their independent nature, each cell needs to be diagnosed for the state of beach stability and provided with appropriate countermeasures against beach erosion. The coastal protection plan is an assortment of countermeasures for individual cells. Alternative plans are to be prepared and examined for individual coastal littoral cells.

The areas to be provided with beach fill and various shore protection facilities have been selected on the basis of the urgency of coastal protection, the state of coastal utilization, the necessity of environmental preservation, and other considerations. The following areas are to be implemented with projects in due course:

1) Mamaia South: beach fill and rehabilitation of two detached breakwaters;
2) Mamaia Center: rehabilitation of four detached breakwaters;
3) Tomis North, Center and South: beach fill, long jetties and submerged breakwaters;
4) Eforie Nord: beach fill, long jetties and submerged breakwaters;
5) Eforie Middle: beach fill, long jetties and submerged breakwaters;
6) Eforie Sud: beach fill, long jetties and submerged breakwaters;
7) Olimp – Venus: beach fill, long jetties and submerged breakwaters; and
8) Saturn – Mangalia: beach fill, long jetties and submerged breakwaters.

The cliff coasts of Tuzla and 23 August are left without protective measures, because land use behind the cliff seems not productive enough to assure sufficient benefit to balance the project cost. The area from 2 Mai to Vama Veche has a marine natural reserve of 5,000 ha between the isobaths of 2 and 20 m, which preserves the richest benthic association in the western part of the Black Sea. Because the wide beaches there can tolerate the present rate of erosion for a certain duration of time to come, no shore protection project is proposed in this area. The beach of Costineşti has been stable without suffering from any erosional problem, and no project is needed there.

The total quantity of various shore protection and rehabilitation facilities and their estimated cost of construction works are listed below.

| | | |
|---|---|---|
| Breakwater rehabilitation: | 1,500 m in total | 15,000 thousand Euro |
| Jetties and groins: | 6,020 m in total | 69,000 thousand Euro |
| Submerged breakwaters: | 4,360 m in total | 69,000 thousand Euro |
| Beach fill: | 3,150,000 $m^3$ in total | 80,000 thousand Euro |
| Removal of existing facilities etc.: | | 13,000 thousand Euro |
| Rehabilitation for Olimp to Mangalia: | | 6,000 thousand Euro |
| Net construction cost: | | 252,000 thousand Euro |
| Total cost of coastal protection plan: | | 316,000 thousand Euro |

The volume of 3.2 million cubic meters of beach fill sand is for the period of 20 years or longer. The annually required volume of sand is 200 thousand cubic meters at most. The volume and cost of beach fill is based on the condition that the river sand of the Danube can be dredged and utilized for the coastal protection plan. If the sea sand to be mined from the seabed off east of Midia Port is used, the required volume will be increased twice or more, because the sea sand is of fine grain size and the beach fill profile become much milder than the case using coarse river sand.

Availability and quality of beach fill sand have been investigated during the Study. It has been identified that the river sand at the location between km 300 and 340 can be utilized for beach fill purpose. However, sand mining from the Danube is a contentious matter from the political and environmental viewpoint. The use of river sand should be subject to further discussion at the stage of environmental impact assessment.

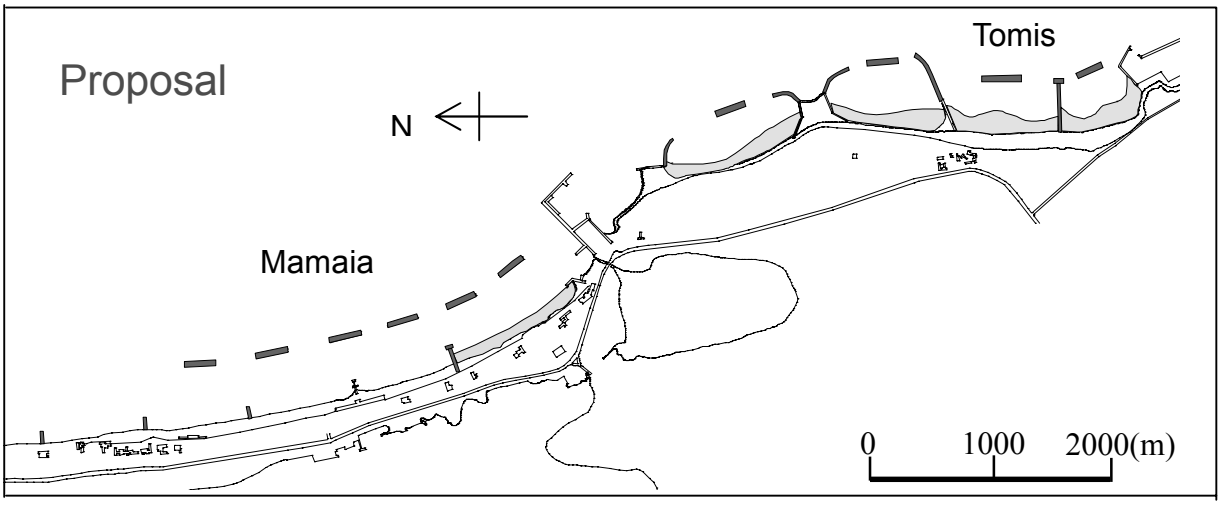


Fig. 1.8: Proposed shore protection facilities at Mamaia and Tomis sub-sectors

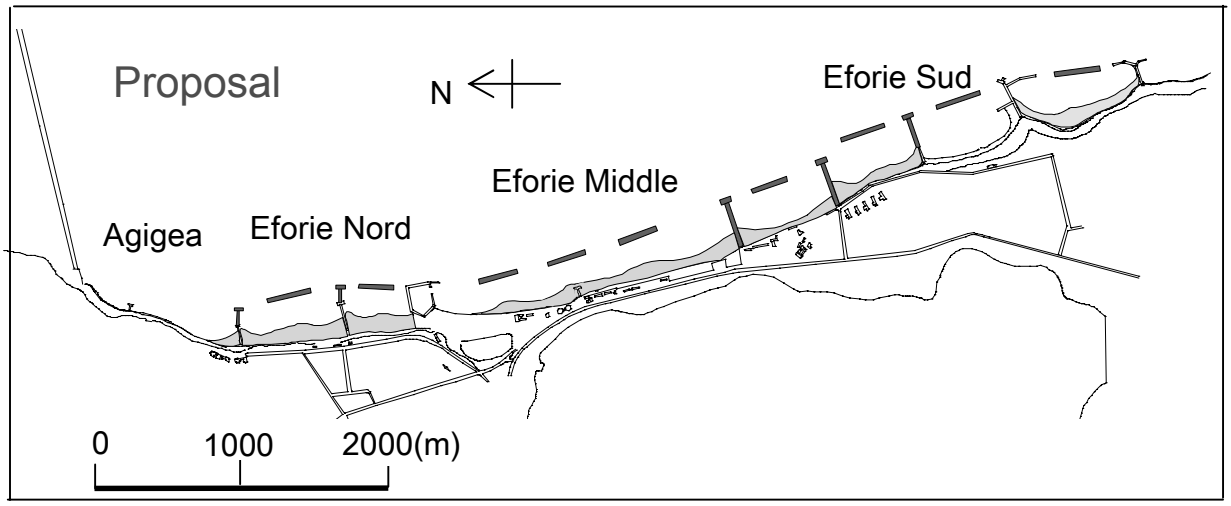


Fig. 1.9: Proposed shore protection facilities at Eforie Sector

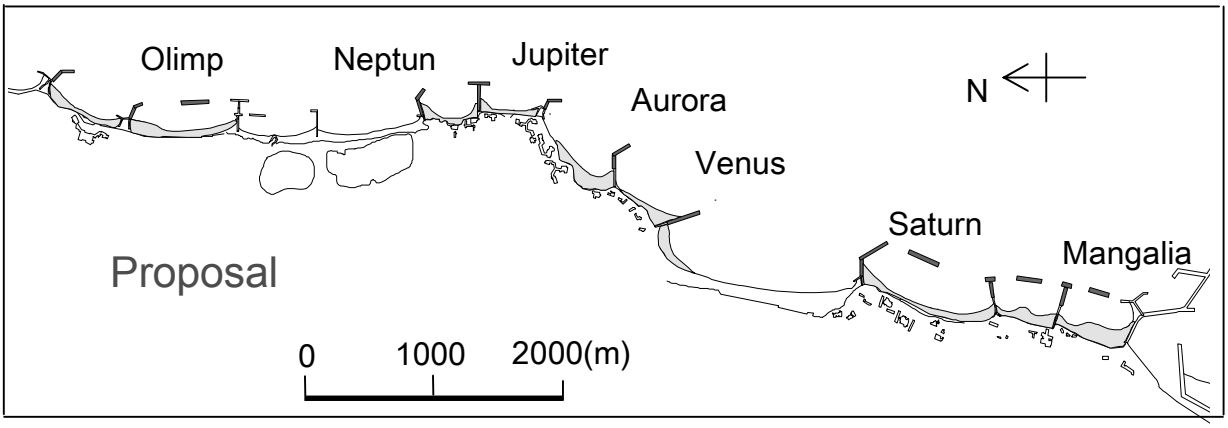


Fig. 1.10: Proposed shore protection facilities at Mangalia Sector

The total cost of 316 million Euro for the overall coastal protection plan is the net construction cost added with the expenses for feasibility studies, engineering services including detailed designs, operational and maintenance cost, and contingency. The cost is an approximate one based on the price in 2005, and thus it does not include the price contingency.

It should be mentioned that the above cost estimate is prepared on the basis of the bathymetric and topographic information available at the end of 2005. For each project to be undertaken from now on, detailed bathymetric and topographic surveys are to be carried out. Design of shore protection facilities will be made with the new information and the cost estimate will be revised accordingly.

### 1.5.4 Source of Beach Fill Sand

Possible sources of beach fill sand examined are as follows: 1) relic barrier beaches in the offshore area, 2) sand layers in the offshore area, 3) sand bars in front of the Sulina Channel, 4) impounded sand deposit at the east of Midia Port, 5) sand shoals on the bed of branch channels of the Danube, and 6) sand deposit in the inland. The sources 1), 2), and 6) were found unsuitable for the present coastal protection plan because of scarcity of available sand volume and/or possible environmental impacts.

Samples of the sea sand in 3) and 4) and the river sand 6) were tested for grain size distribution, heavy mineral content, and organic pollutants. Both the sea sand and the river sand were found to contain no harmful materials. The sea sand is characterized with small grain size (median diameter of around 0.1 mm) and contained a fraction of silt and clay depending on the location. The grain size of the river sand is 0.2 to 0.3 mm. Because the beach fill sand should have a large grain size to be capable of staying for longer time against wave actions, the sea sand is not a favorable choice.

The river sand has been mined as construction materials for many years under the permit of the National Administration of Mineral Resources. The recent volume of mined sand in the km 271 to km 373 is about 100 to 150 thousand cubic meters per year, which is less than 20 percent of the authorized volume. With availability of further sand mining from the Danube within the authorized volume, the river sand can be used for beach fill works.

The present Study is being conducted with the assumption that the river sand of the Danube could be used as the beach fill material. However, sand mining from the Danube is a contentious matter from the political and environmental viewpoint. From the technical viewpoint, it would be necessary to examine riverbed geomorphology change, however, in this respect, it has been agreed that the Romanian authorities could provide a guidance, making use of the EIA study for another project on the navigation improvement of the Danube with regard to the possible impact on riverbed geomorphology by the priority projects at Mamaia and Eforie. Thus, the scientific assessment of potential morphological changes by sand mining is not implemented in this Study.

### 1.5.5 Implementation Schedule (Section 5.8)

Originally the coastal protection plan for the southern Romanian Black Sea shore was aimed to be completed by the year 2020. However, in consideration of the required volume of construction materials and the estimated total cost, it is proposed to extend the target year to a later date by dividing the plan into two stages: for the initial 14 years and the second stage after the 15th year. The first stage is further divided into three phases. The areas to be included in each phase and the project cost are as listed in Table I-1.

Since this project is subject to strategic environmental assessment (SEA) and environmental impact assessment (EIA), careful response by the proponent is required. Because of the uncertainty on the time of the first project implementation, the schedule is given not in the calendar year but the consecutive year after the start of the coastal protection plan.

Table 1.1: Implementation schedule and estimated project cost

| Stage | Phase | Year | Area | Project cost (million Euros) |
|---|---|---|---|---|
| First | First | 1st – 4th | Mamaia, Eforie Nord (part) | 44 |
| | Second | 5th – 8th | Mamaia Center (part), Tomis North, Eforie Middle | 65 |
| | Third | 8th – 14th | Mamaia Center (part), Tomis Center, Eforie Nord (part), Eforie Sud (part) | 68 |
| | overall | 1st – 14th | Mamaia to Eforie Sud (part) | 177 |
| Second | overall | After 15th year | Tomis South, Eforie Sud (part), Olimp – Venus, Saturn – Mangalia | 139 |

During the first stage, a certain amount of rehabilitation works for the areas from Olimp to Mangalia should be planned, and the rest of those works should be planned during second stage.

### 1.5.6 Priority Projects (Chapter 6)

The projects earmarked in the first phase of the first stage are the priority projects that will be implemented in the areas of Mamaia South and a part of Eforie Nord. Selection of these sites was made at the second steering committee of the Study on November 4, 2005. The selection was acknowledged by the stakeholders at the meetings at Constanța and Bucharest on November 24 and 25, 2005, respectively. Likewise the priority project site selection was recognized by the stakeholders at the Constanța meeting on June 5, 2006.

In Mamaia South, two southernmost breakwaters are rehabilitated with backing of rubble mounds and stabilopods armoring and a beach fill is executed with 180,000 $m^3$ of river sand. A sand-retaining groin of 200 m long and three submerged groins of 100 m long each are constructed. In case of sea sand for beach fill, the sand volume is increased to 460,000 $m^3$ and an underwater dike of 1,200 m long to retain the filled sand must be constructed.

In Eforie Nord, the area with the alongshore distance of 1,200 m at the north side of the marina "Yacht Club Europa" is to be protected with two long jetties, two submerged breakwaters and a beach fill with 330,000$m^3$ of river sand. In case of sea sand for beach fill,

the sand volume is increased to 740,000 $m^3$ and an underwater dike of 1,200 m long must be constructed.

The feasibility study of the priority projects at Mamaia South and Eforie Nord has been carried out in May to July, 2006 and presented in Volume 2 of the present Draft Final Report. It should be mentioned that the above figures of the volumes of beach fill sand and the lengths of structures are somewhat different from those designed in the feasibility study, because the former figures have been derived on the basis of insufficient information of bathymetric and topographic survey result in the end of 2005.

### 1.5.7 Environmental and Social Considerations

First, a survey is made on the policy, legal aspects and administrative framework of environmental protection in Romania. Tables of the elements and assessment standards have been prepared for various environmental factors. Then, the environmental conditions in the coastal sectors are described with some details on the ecosystem.

The initial environmental examination of the coastal protection plan for the Southern Romanian Black Sea shore begins with an overview of the shore protection projects considered in the Coastal Protection Plan for the Southern Romanian Black Sea shore. Thirty items stipulated in the JICA guidelines have been examined by the Study team as well as the stakeholders in Romania

The stakeholder meeting has been held five times in Constanța and twice in Bucharest from June 2005 to June 2006. During the initial three meetings, the outline of the Study and the on-going planning of coastal protection and rehabilitation were presented to the participating stakeholders.

Based on the scoping of the influential items, a study of initial environmental examination of the coastal protection plan was commissioned to the National Institute of Marine Geology and Geo-ecology. The twelve screened items were examined for their nature and degrees of impacts such as those direct or indirect, temporal (during construction) or permanent, local or regional, mitigable fully or partially, and monitoring capable fully or partially. The degrees of impact were assessed for eight coastal units within the study area on the twelve screened items.

The fourth and fifth stakeholder meetings in November 2005 acknowledged the selection of the priority project sites at Mamaia South and Eforie Nord. Some discussions were made on the possible impacts of the implementation of priority projects on environment and society. The sixth stakeholder meeting in March 2006 was concerned with the overall coastal protection plan, which was finalized and presented by the Study team. The priority project sites of Mamaia South and Eforie Nord was finally confirmed by the stakeholders attending the seventh meeting in June 2006.

Romania has introduced the Strategic Environment Assessment (SEA) procedure in 2004 and begun its execution 2006. The Coastal Protection Plan has been selected as the first case of the SEA procedure. The Ministry of Environment and Water Management made a contract with an authorized environmental consultant firm for assisting SEA in October 2006. The consultant firm utilized the initial environmental examination report and the Interim Report of the Study for preparation of the SEA report, which was submitted to the Ministry in February

2007. The SEA report pointed out that a part of coastal protection facilities planned at the Eforie Sector may have significant environmental impacts. To avoid the environmental impacts, the original coastal protection plan at the Eforie Sector has been partially modified. The facilities proposed in Fig. 1.9 are those after modification.

The public debate regarding the SEA on the Coastal Protection Plan was held at Constanţa on March 29, 2007 for discussion on the Master Plan. Meantime, the number of participants was 49 (including 19 numbers related to the Study). In response to the result of public debate, environmental approval on Coastal Protection Plan as the Master Plan was issued by The Ministry of Environment and Water Management with the final decision numbered 13/05 07 09 and the SEA procedure was completed in July of 2007.

### 1.5.8 Administration and Monitoring of Coastal Protection Plan

The coastal protection plan has to be administered for a long period of time, say more than 20 years, because of the limited financial resources available in Romania and the long coastline to be protected. To ensure the realization of the coastal protection plan, there should be established a special coastal administrative unit within the Ministry of Environment and Water Management (MoEWM) in charge of coastal protection and rehabilitation. At the same time, the corresponding sections should be established in the National Administration Romanian Waters (ANAL) and the Water Directorate Dobrogea Litoral (DADL).

The coastal administrative unit together with the corresponding sections will be charged with the responsibility of effective and efficient execution of the coastal protection plan consecutively year after year. They will also be responsible for preparing and executing the plans for monitoring geophysical, environmental, and structuring aspects of the coastal areas. Undertaking of timely operations for maintenance beach fill is also necessary, because mitigation against beach erosion always requires maintenance works. Details of the monitoring plan are given in Chapter 6 of Volume 2.

### 1.5.9 Management Assessment and Institutional Aspects

An overview of project implementation framework is provided with two projects financed by EU and World Bank for reference. Then the fund management and auditing systems are discussed with examples of several international financing institutions. Availability of project financing to the coastal protection plan is explained by listing possible international funds. Budgetary process in Romania is described together with the procedure of external borrowing. Affordability analysis will be provided in Volume 2 in relation with the feasibility study for the projects at Mamaia South and Eforie Nord.

## 1.6 Recommendations and Further Issues

### 1.6.1 Recommendations

The following five recommendations related to the Study are made:

1) Establishment of special coastal administrative unit with the minimum number of four permanent staff;
2) Collaboration with LEPA and authorities in charge of sewerage system for improvement of water quality in the nearshore water area;

3) Formulation of coastal protection plan for the northern unit of the Romanian Black Sea shore;
4) Development of expertise in coastal engineering in Romania; and
5) Investigation of the mechanism of long-period fluctuations of water level and their effect on water circulation along the Black Sea shore.

Explanation of these recommendations is given in **9.2**.

### 1.6.2 Further Issues

Key to the successful and efficient implementation of a project is the planning/managerial and operational capacities of the administrative and operational bodies, namely, MoEWM, ANAR Headquarters and/or DADL. MoEWM has the responsibility to promote the Plan over a long time span. It should first establish a special coastal administrative unit to strengthen its capacity as recommended in **1.6.1**. The most urgent task for the priority projects the establishment of the project implementation unit (PIU) with clearly defined authority and power in procurements and fund management.

To make financial analysis in compliance with the financial and economic guidelines for project analysis of external financing resources, it is definitely in need to examine fiscal capacity of MoEWM to appropriate capital and recurrent budgets to DADL through ANAR or directly to ANAR Headquarters for the foreseeable period of project horizon, say, up to 2040. Budgeting to the project implementing body (or bodies) is the task of the Romanian side, because it is a policy matter beyond the reach of the Study team.

Although the present JICA Study formulated the coastal protection plan for the southern unit of the Romanian Black Sea shore, the northern unit where beach erosion is much severe should also be provided with an appropriate protection plan.

Last, but not least, the forthcoming feasibility study with a focus on the institutional, financial and economic aspects of the prospective projects on the Romanian Southern Black Sea shore will need to expeditiously be undertaken, while considering the indicative timing and schedule of the application for the external funds.

# PART 2

## FEASIBILITY STUDY OF COASTAL PROTECTION AND REHABILITATION PROJECT AT MAMAIA SUD AND EFORIE NORD

# PART 2 FEASIBILITY STUDY OF COASTAL PROTECTION AND REHABILITATION PROJECT AT MAMAIA SUD AND EFORIE NORD

## 2.1 Selection of Feasibility Study Sites

The Coastal Protection Plan for the Southern Romanian Black Sea Shore has designated nine sub-sectors among twenty sub-sectors as the areas that require implementation of coastal protection and rehabilitation projects. Based on examination and comparison of the urgency of coastal protection, beach utilization, economical feasibility of project implementation, and needs for promotion of regional development, the sub-sectors of Mamaia Sud and Eforie Nord were selected as the sites of priority implementation of the coastal protection and rehabilitation projects. The selection was made at the Steering Committee held on November 4, 2005 and was acknowledged by the stakeholders in the meetings held in Constanța on November 24 and in Bucharest on November 25, 2005. The selection was further confirmed at the stakeholder meeting held in Constanța on June 6, 2006.

A feasibility study for the coastal protection and rehabilitation project at Mamaia Sud and Eforie Nord was carried out by the JICA Study team. An executive summary of this feasibility study is presented hereinafter.

## 2.2 Project Objectives and Justification

The objectives of the Project are to relieve the coastal areas of Mamaia Sud and Eforie Nord from the threat of coastal erosion and to enhance the beach utilization through enlargement of beach areas.

Justification of the Project is made hereinafter. The project site at Mamaia Sud has been plagued by the acute progress of beach erosion that amounts to the rate of 2.0 m per year. The narrowest beach width at the southern end of Mamaia beach is only 20 m from the edge of a shop on beach. In less than 10 years, the shop will be destroyed by waves if no protective measures are taken. The seaward edges of the buildings of Hotel Parc and Hotel Dacia are located at the distance of about 40 m from the present shoreline. Structural damage to the buildings will start within 20 years without project implementation. The project aims at widening beaches by bringing sand from outside sources to mitigate further beach erosion. The enlarge beach area will greatly contribute to the local tourism.

The beach at Eforie Nord is very narrow and sandy beach disappears in the north of Restaurant Acapulco. It has been verified that the project site area has retreated by some 40 m during the past 78 years. Since the project site area is basically a cliff coast of about 10 m high, the shoreline retreat is associated with the gradual collapse of cliffs. Further possibility of cliff collapse threatens the safety of hotels, restaurants and other buildings built near the cliff edge.

Expansion of the beach at the foot of the cliff provides a valuable space for cliff stabilization works, which will be composed of reformation of the cliff slope into milder gradient, provision of efficient drainage systems, and revetments at the foot of cliff for protection against the scouring action of waves. New sandy beach to be created by the Project will

attract many tourists to the area and contribute to the local economy.

## 2.3 General Description of the Project

### (1) General

The general information of the Project is as follows:

| | |
|---|---|
| *Project Name*: | Coastal Protection and Rehabilitation Project at Mamaia Sud and Eforie Nord |
| *Component "A"*: | Coastal Protection and Rehabilitation Works at Mamaia Sud |
| *Component "B"*: | Coastal Protection and Rehabilitation Works at Eforie Nord |
| *Beneficiary*: | National Administration of Romanian Waters<br>The Department of Waters Dobrogea – Litoral<br>Constanța, Romania |
| *Consultant*: | ECOH CORPORATION<br>2-6-4 Kita-Ueno, Taito-ku, Tokyo 110-0014, Japan<br>tel: +81-3-5828-8412, fax: +81-3-5828-8418 |

The sites of the two components are separated by about 17 km, and their construction works are carried out independently.

### (2) Major works

The major items of construction works at the Component "A" at Mamaia Sud are as follows:

| | |
|---|---|
| Beach fill: | alongshore distance of 1.2 km, beach width increase of 50 m, and sand volume of 224,000 $m^3$. |
| Rehabilitation of two (2) breakwaters: | length of 250 m each. |
| Construction of one (1) sand retaining jetty: | length of 200 m. |
| Construction of three (3) submerged groins: | length of 100 m each. |

The major items of construction works at the Component "B" at Eforie Nord are as follows:

| | |
|---|---|
| Beach fill: | alongshore distance of 1.2 km, beach width increase of 80m, and sand volume of 467,000 $m^3$. |
| Rehabilitation and extension of one existing jetty: | extension length of 60 m. |
| Rehabilitation of one existing jetty: | length of 180 m. |
| Construction of three (3) submerged breakwaters: | lengths of 200m, 200m, and 275 m. |

In addition to the above, four existing short groins in Eforie Nord are removed for safety of beach users and their debris is recycled as the core materials of submerged breakwaters. The volumes of beach fill sand slightly differ from those estimated at the time of formulating the Coastal Protection Plan for the Southern Romanian Black Sea Shore, because the preliminary design works in the feasibility study are based on the new information obtained by the bathymetric and topographic surveys specially commissioned for the feasibility study.

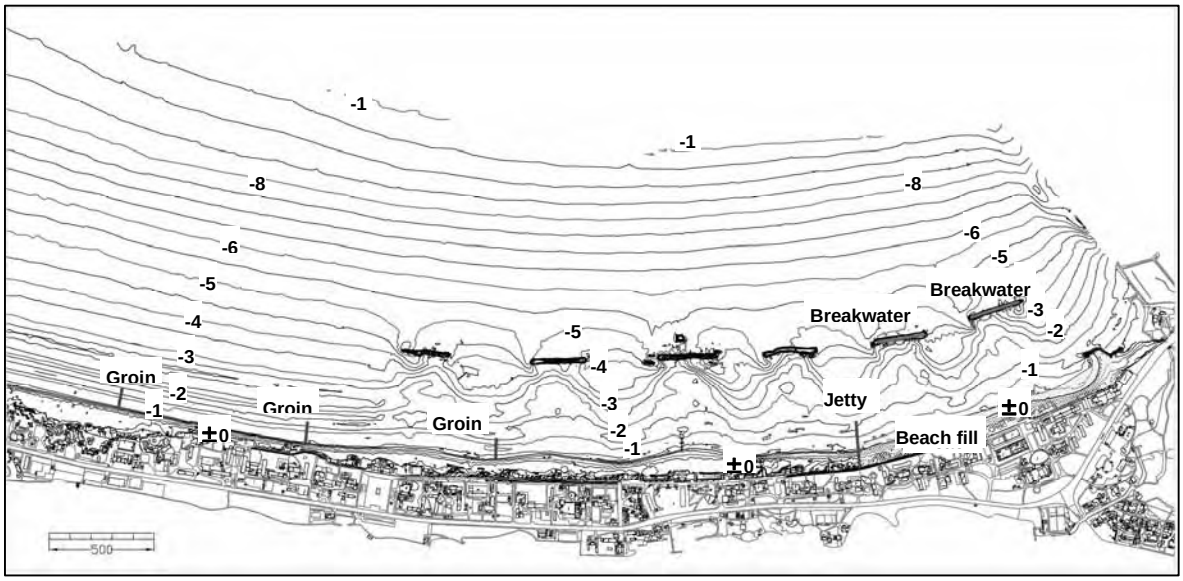


Fig. 2.1: Layout of the shore protection facilities around Mamaia Sud

Fig. 2.2: Bird's-eye view of the beach after project implementation at Mamaia Sud

Figures 2.1 and 2.2 show the layout of the shore protection facilities and a bird's-eye view of the beach after project implementation at Mamaia Sud, respectively. The two existing breakwaters to be rehabilitated are shown in red color in Fig. 2.1. Other four breakwaters are not rehabilitated in the present project. The jetty at the left end of beach fill area is built for retaining filled sand within the fill area. Three groins (submerged) at the left to center bottom are provided there to slow down the longshore currents induced by waves and to reduce the alongshore sediment transport.

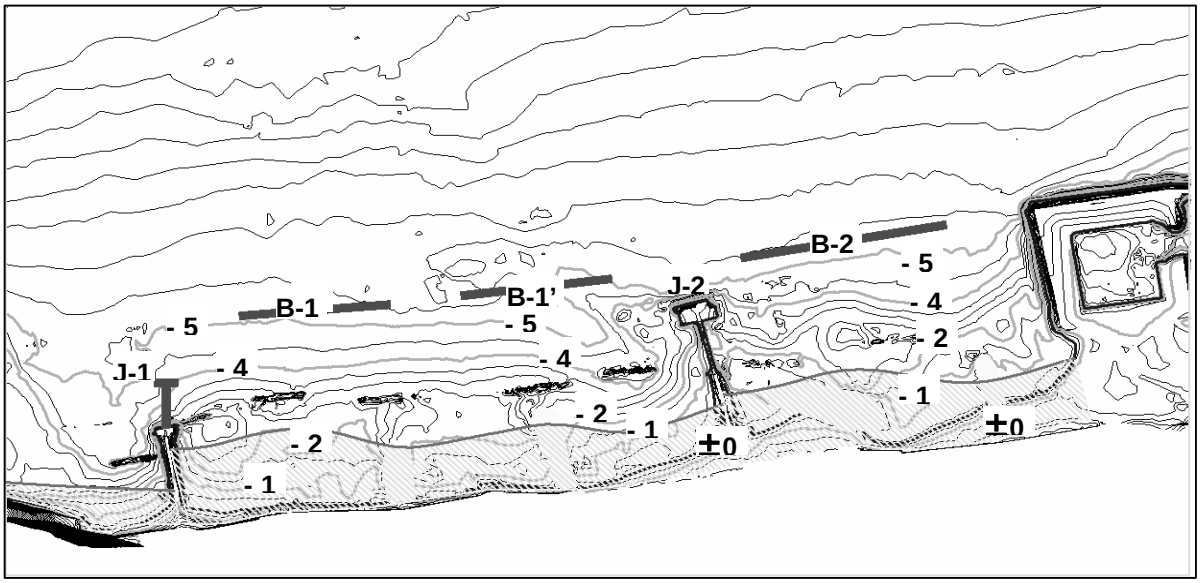


Fig. 2.3: Layout of the shore protection facilities at Eforie Nord
with the shoreline in one year after the beach fill

Fig. 2.4: Bird's-eye view of the beach after project implementation at Eforie Nord

Figures 2.3 and 2.4 show the layout of the shore protection facilities and a bird's-eye view of the beach after project implementation at Eforie Nord, respectively. The breakwaters marked as B-1, B-1', and B-2 are all submerged type with wide crests. The jetty J-1 is extended by 60 m with rehabilitation of the existing section. The jetty J-2 is rehabilitated for the whole section.

### (3) Beach fill sand

The principal candidate source of beach fill sand is the riverbed of the Danube in the location between km 305 to km 340, provided that the permit of sand mining will be issued by the National

Administration for Mineral Resources and the mining operation will be authorized by the River Administration of the Lower Danube, Galati and the National Administration of Romanian Waters. The environmental agreement for sand mining must also be obtained through the Environmental Impact Assessment for the priority project.

The beach fill sand should be medium to coarse sand with the median diameter of 0.20 to 0.30 mm for the Component "A" at Mamaia Sud and 0.35 to 0.45 mm for the Component "B" at Eforie Nord. The sand should contain no silt fraction.

## 2.4 Main Alternatives Studied and Main Reasons for the Final Choice

### 2.4.1 Alternatives Studied for Mamaia Sud

In designing the shore protection facilities and their layout of the Component "A" at Mamaia Sud, the following four items of component options were taken into consideration:

1) Option of the river sand or the sea sand for beach fill,
2) Option of the crest elevation of two detached breakwaters to be rehabilitated:
   Choice of the crest elevation of +2.4 m or +1.0 m,
3) Option of the extension length of two detached breakwaters to be rehabilitated:
   Choice of present length of 250 m or extended lengths of 350 m, and
4) Options of the length of sand-retaining jetty at the northern boundary of beach fill area:
   Choice of the length of 210 or 120 m (310 or 220 m in case of sea sand),

Nine alternative plans including "zero-option" alternative were selected by rational combinations of the above four options. The alternative plans were examined for their capacity to mitigate beach erosion, aesthetic factor of ocean view, and construction cost.

Use of the river sand is less expensive than the sea sand and slightly more stable; the total project cost using the river and sea sand has been estimated as 11.5 and 19.0 million Euro, respectively. It was agreed at the Steering Committee meeting held on August 22, 2006 that the beach fill will be executed by using the river sand unless the environmental impact assessment demands the use of sea sand. The second item of the crest elevation of rehabilitated breakwaters was concluded to employ a lower elevation of +1.0 m to reduce the aesthetic impact as much as possible. The third and fourth items were mainly examined from the viewpoint of erosion mitigation capacity. Extension of existing breakwater by 100 m increases the effectiveness of beach protection, but the degree of increase is not large enough to compensate an increase in construction cost and the adverse effect on the aesthetic view will be brought in. Shortening of the sand-retaining jetty decreases the sand retaining capacity and induces rapid retreat of the beach fill shoreline. Thus, the third option of breakwater extension and the fourth option of short jetty were rejected.

### 2.4.2 Alternatives Studied for Eforie Nord

In designing the shore protection facilities and their layout of the Component "B" at Eforie Nord, the following four items of component options were taken into consideration:

1) Option of the river sand or the sea sand for beach fill,
2) Construction of the extended portion of the two jetties (EN-J-1 and EN-J-2):
   Choice of 60 and 150 m for EN-J-1 and 0 and 25 m for EN-J-2,

3) Construction of submerged breakwaters:
   Choice of two breakwaters (EN-B-1 and EN-B-2) or three breakwaters (EN-B-1, EN-B-1' and EN-B-2), and

4) Crest elevation of submerged breakwaters:
   Choice of submerged or emerged breakwaters

A preliminary cost comparison was made between the use of river and sea sand for beach fill at Eforie Nord (see **2.5.3**). Because the sediment on beach and inshore there is made of medium to coarse sand, beach fill using the sea sand which is very fine in grain size will require a large volume of sea sand and underwater dikes to prevent the sand from flowing out from the fill area. The total project cost using the river sand and the sea sand was estimated as 28.7 and 54.1 million Euro, respectively. Because of the large cost difference, use of the sea sand at Eforie Nord was discarded and the decision was supported by the Steering Committee at the meeting on August 22, 2006.

The third option of emerged reefs was rejected from the aesthetic viewpoint and its adverse impact on water quality due to less efficient water circulation. Four alternative plans including "zero-option" alternative were selected by rational combinations of the second and third options. They were mainly examined from the viewpoint of erosion mitigation capacity. Because the project site is bounded by the south breakwater of Constanța Port at the northern side and the breakwater of "Yacht Club Europa" Marine at the southern side, the alongshore sediment transport rate is small, and the difference between the alternative plans except "zero-option" was not large. Nevertheless, the plan shown in Fig. 2.3 demonstrated the best performance with the least cost.

## 2.5 Project Cost and Implementation Schedule

### 2.5.1 Component "A" at Mamaia Sud

Because of the uncertainty of the exact date when the fund for the Project is secured in an early time of the year 2007 and the Project Implementation Unit (PIU) is established, the implementation schedule is counted from the year after the provision of the fund. The Project Component "A" at Mamaia Sud is scheduled to start in July of the first year and to be completed by December of the second year. The following is the periods of major construction works:

| | |
|---|---|
| - rehabilitation of the first detached breakwater: | August to November of the first year |
| - rehabilitation of the second detached breakwater: | May to August of the second year |
| - sand-retaining jetty: | October of the first year to February of the second year |
| - submerged groins: | October of the first year to May of the second year |
| - beach fill: | March to May of the first year and September to November of the second year |

Major construction works are carried out in the off-season of summer tourism. However, rehabilitation works of existing breakwaters which are executed by floating vessels at the distance of 500 m from the shore are continued throughout the year, because they will not interfere the beach users in the summer season.

The total project cost of the Component "A" is estimated as 11.53 million Euro on the basis of the market price in the summer of 2006,, and the works-wise cost breakdown is listed in Table 2.1.

Table 2.1: Works-wise cost breakdown of project cost at Mamaia Sud using river sand

(units: million Euro)

| No. | Item | Quantity | Amount |
|---|---|---|---|
| 1 | Construction works | | |
| | Beach fill | 224,000 $m^3$ | 4.72 |
| | Rehabilitation of detached breakwaters | 2 @ 250 m | 2.81 |
| | Sand-retaining jetty | 200 m | 0.66 |
| | Submerged groins | 3 @ 100 m | 0.64 |
| | Supplementary submerged groins | 3 @ 70 m | 0.13 |
| | Temporary access road | 1 unit | 0.30 |
| | Net construction cost | | 9.26 |
| 2 | Management and monitoring cost | | 0.84 |
| 3 | Engineering Service | | 0.65 |
| 4 | Taxes and public charges | | 0.23 |
| 5 | Base cost | | 10.98 |
| 6 | Contingency | | 0.55 |
| 7 | TOTAL | | 11.53 |

Note: 1) The engineering service fee is estimated as 7% of the net construction cost.
2) The taxes and public charges are estimated as 2.5% of the net construction cost.
3) The contingency is estimated as 5% of the base cost.
4) All the cost is based on the market price in the summer of 2006.

### 2.5.2 Component "B" at Eforie Nord

With the condition same as that for the Component "A,", the Project Component "B" at Eforie Nord is scheduled to start in January of the third year and to be completed by June of the fourth year. The following is the periods of major construction works:

- Removal of existing short groins: February to May of the third year
- Submerged breakwaters: February to December of the third year
- Rehabilitation and extension of two jetties: February to May of the third year with minor works from October of the third year to May of the fourth year
- Beach fill: March to May of the third year and September of third year to May of the fourth year

Major construction works are carried out in the off-season of summer tourism. However, construction of submerged breakwaters which are executed by floating vessels at the distance of 300 m from the shore are continued throughout the year, because it will not interfere the beach users in the summer season. When the construction works are completed as scheduled, the new beach at Eforie Nord will be fully available for the beach users in the summer of the fourth year.

The total project cost of the Component "B" is estimated as 28.72million Euro on the basis of the market price in the summer of 2006,, and the works-wise cost breakdown is listed in Table 2.2.

Table 2.2: Works-wise cost breakdown of project cost at Eforie Nord using river sand

(units: million Euro)

| No. | Item | Quantity | Amount |
|---|---|---|---|
| 1 | Construction works | | |
| | Beach fill | 467,000 $m^3$ | 8.82 |
| | Submerged breakwaters (3 units) | 675 m in total | 12.14 |
| | Rehabilitation of Jetty J-1 | 146 m | 0.46 |
| | Extension of Jetty J-1 | 60 m | 0.99 |
| | Rehabilitation of Jetty J-2 | 200 m | 1.02 |
| | Removal of existing groins | 1 unit | 0.45 |
| | Temporary access road | 500 m | 0.34 |
| | Net construction cost | | 24.22 |
| 2 | Management and monitoring cost | | 0.82 |
| 3 | Engineering Service | | 1.70 |
| 4 | Taxes and duties | | 0.61 |
| 5 | Base cost | | 27.35 |
| 6 | Contingency | | 1.37 |
| 7 | TOTAL | | 28.72 |

Note: 1) The engineering service fee is estimated as 7% of the net construction cost.
2) The taxes and public charges are estimated as 2.5% of the net construction cost.
3) The contingency is estimated as 5% of the base cost.
4) All the cost is based on the market price in the summer of 2006.

### 2.5.3 Total Project Cost of Components "A" and "B"

The Coastal Protection and Rehabilitation Project at Mamaia Sud and Eforie Nord is estimated to cost 40.25 million Euro excluding price contingency, based on the market price in the summer of 2006. Its breakdown into the foreign and local costs is listed in Table 2.3.

Table 2.3: Total project cost of Components "A" and "B"

(units: million Euro)

| No. | Item | Foreign Cost | Local Cost | Total Cost |
|---|---|---|---|---|
| 1 | Material | 1.01 | 7.14 | 8.15 |
| 2 | Equipment | 0.00 | 17.30 | 17.30 |
| 3 | Labor Cost | 3.25 | 4.78 | 8.03 |
| | Skilled | 3.25 | 3.30 | 6.55 |
| | Unskilled | 0.00 | 1.48 | 1.48 |
| 4 | Management (PIU) and monitoring cost | 0.50 | 1.16 | 1.66 |
| 5 | Engineering Service | 1.41 | 0.94 | 2.35 |
| 6 | Taxes and Duties | 0.00 | 0.84 | 0.84 |
| 7 | Base Cost | 6.17 | 32.16 | 38.33 |
| 8 | Physical Contingency (Base Cost ×5%) | 0.31 | 1.61 | 1.92 |
| 9 | TOTAL | 6.48 | 33.77 | 40.25 |

If the environmental agreement based on the environmental impact assessment is issued on the condition of using the sea sand around Midia Port instead of the river sand from the Danube for the Project Component "A", the total project cost will be increased by 7.44 million Euro to the amount of 47.69 million Euro. In a bid to estimate a whole financing need for the project, price contingency is added to the above project cost as reflected in **7.2.3**.

## 2.6 Potential Environmental Impacts and Mitigation Measures

### (1) Water

Potential impact of the project implementation is the turbidity associated with mining and placement of beach fill sand. In case of the river sand from the Danube, turbidity by sand mining is negligible because of the turbid river water with suspended sediment. Its placement on the beach and inshore water will not yield turbidity because of little content of silty fractions. Thus, the environmental impact will be of low level.

In case of the sea sand, it may contain a certain amount of silt and mud fractions depending on the dredging locations. Turbidity will be generated at both the dredging and the beach fill sites. However, silty sediment will be settled down after elapse of a certain time and will not affect the water quality in a long time span. Thus, the environmental impact will be of moderate level. Nevertheless, whenever water pollution by turbidity is anticipated, some silt protection measures such as silt protection screens should be spread out around the work site.

Another source of water pollution is a possible oil spill from working vessels and other construction equipment. Every care is to be taken to prevent oil spill.

Basically, there will be no water pollution impact by construction works. Nevertheless, the water pollution problem owing to eutrophication is still present. In case of no further improvement of wastewater treatment installations including full administration of pipeline systems, there may appear a possibility of water quality degradation by construction of shore protection facilities owing to potential decrease of water circulation in the nearshore zone. Close collaboration with another EU project on wastewater treatment plants at Mamaia and Eforie Sud and timely adjustment of execution schedules of coastal protection and wastewater treatment projects will be called for.

### (2) Air

A possible source of air pollution is the exhaust gas emitted during the operation of sand mining, transport of beach fill sand and other construction materials, and vessels and equipment employed in construction. Because the sand mining is carried out at the places far from inhabited areas, impact on air quality is hardly expected.

The transport of the river sand for beach fill is executed by hopper barges through the Danube – Black Sea Canal and dump trucks on roads. The maximum daily traffic of 25-ton trucks is estimated to be less than 200 trips. Because the routes of sand transport are already utilized by 1,300 to 4,200 large vehicles per 12 hours according to the traffic survey in June 2006, addition of the truck traffic by the project will increase the traffic load only modestly and the increase of air pollution will be slight. Thus the impact on air quality will be of low to moderate level.

Nevertheless, proper maintenance of dump trucks and other equipment should be administered to minimize the pollution load.

### (3) Noise and vibration

A possible source of noise and vibration is the traffic of dump trucks carrying beach fill sand and other construction materials. Increase of traffic volume by the project is small as mentioned above, and the impact of noise and vibration on the area along the road will be of low to moderate level. Nevertheless, no construction activities will be carried out during the night-time, and proper maintenance of the engines should be administered to avoid malfunctions which result in increased noise.

### (4) Fauna, flora and biodiversity

There are some species of flora in water along the riverbanks of the Danube river, but few flora can grow in the turbid water of several meters deep on the sand shoals. Thus little impact on flora will be expected. As to fauna, there are fresh-water shells of common species. Detailed assessment on impact to fauna and flora with sand mining would be implemented in the following environmental impact assessment.

For the beach fill works in Mamaia Sud and Eforie Nord, low impact is expected on benthos and benthic plants and marine biodiversity, because the damage to benthos by covering of seabed with beach filling sand will be recovered soon by natural process.

On the long term, the installation of submerged breakwaters and jetties provides the water area with new additional hard bottoms and they will have positive effects of enhancing biodiversity.

Thus, the impact on fauna, flora and biodiversity will be of low to moderate level. However, monitoring of fauna, flora and biodiversity around the sand mining area as well as the project sites should be undertaken in order to ensure no adverse effect by the project implementation.

Dredging vessels and equipment for sand mining must observe the internal and international rules for the navigable routes pollution protection.

### (5) Landscape

The beach of Mamaia Sud has a series of six detached breakwaters which were built in 1989 to 1990. Beach is very narrow at its southern area. The Project rehabilitates the two existing breakwater by widening them with installation of rear rubble mounds and protecting them with armour blocks of stabilopods. However, the crest is set at the same elevation as before and the scenery from the shore will be the same as the present one. The sand-retaining jetty may bring forth an impression of discontinuity of a long continuous shoreline, but the beach fill is so designed to minimize the difference between the shoreline positions across the jetty. Expanded beach width will provide beach visitors with ample space for sunbathing and weaken the impression of discontinuous shoreline.

Changes in the beach scenery of Eforie Nord by implementation of the project are disappearance of short groins, rehabilitated two long jetties, and widened beach area. Presence of submerged breakwaters is only noticeable with a series of sea marks emerged on top of

reefs. No objections to the new beach scenery will be raised by beach visitors.

Thus, the impact on landscape by the project implementation will be of low to moderate level.

### (6) Waste

Construction works for the project yields little amount of waste, because main construction materials are sand, stones, concrete blocks, and fresh concrete, which are all utilized in facility construction. Demolished short groins at Eforie Nord yield stones and fragments of concrete blocks, but they are recycled as the core materials of submerged breakwaters located in the offshore.

There will be no lodging facilities for workers and thus no sleep-in workers in the project. Household waste will be kept minimal and treated properly.

Thus, the impact on waste by the project implementation will be of low level.

### (7) Bottom sediment

Sediment samples of the river sand of the Danube indicated that the contents of the heavy metals Cd, Cr, Cu, Pb, and Zn are well below the limits concentration by the Romanian regulations. The concentrations of total petroleum hydrocarbon (TPH) are below the detectable level 25 mg/kg d.w.[1] and the organoclorinate pesticides are below the detectable level 0.001 mg/kg d.w. There are detected a certain level of the polycyclical aromatic hydrocarbons (PAH), but no specific regulations are in force with regard to PAH.

The concentration levels of heavy metals, TPH, PAH in the river sand are of the same levels with the sea bottom sediment of Mamaia Sud and Eforie Nord. Therefore, significant impacts on the bottom sediments by the implementation of such project using river sand cannot be predicted at this time without further studies on forecasting and evaluation in detailed EIA.

### (8) Fishery

Potential impacts by the project using the river sand on fishery are temporal minor turbidity by sand placement in the nearshore water, inconvenience to fishermen by temporal use of fishing harbor area by working vessels, departure of fish from the water area of the project site by noise of construction works, and others. However, the construction works are limited to the water area shallower than 5 m, where the fish resources are few. Installation of submerged breakwaters and other facilities, on the other hand, has positive ecological effects by providing hard underwater surface which has ecological and bioproductive potential higher than sandy seabed.

Thus, the impact on fishery by the project implementation using the river sand will be of low level.. When the sea sand around Midia Port is used for beach fill, some moderate impact on fishery is expected because of the turbidity generated during dredging and placement of beach fill sand.

[1] d.w.: dry weight

### (9) Social and economic environment

The project sites of Mamaia Sud and Eforie Nord are situated amidst the summer resort beach zones, with a large number of tourists and visitors in hot season and just a little number of permanent inhabitants in the sites. Owners and staff of hotels, restaurants, bars and other enterprises move out from the beach areas in the off-season. The Project does not require any land acquisition, because all the works are made on beach and nearshore water areas. There is no possibility of involuntary resettlement of inhabitants. Thus, little impact on the social environment is expected by the project implementation.

As for the economic environment, no adverse effect is expected. Rather, positive effects such as the enhancement of the tourism industry by increased number of visitors to the region and the improvement of labor market by way of amplified number of workers in the hotel and restaurant sector are expected in the wake of the project completion. Construction works during the project implementation will generate incremental employment of laborers up to some 800.

### (10) Other environmental factors

The project does not induce any impact on soil and subsoil, because it engages in the shore area only.

There are no submerged sites of historical and/or cultural importance, which have been known in the work areas. If such sites will be identified during construction, they will be preserved and investigated in compliance with the related law.

The local conflict of interest may arise from the misdistribution of benefits produced after the project implementation. Main direct beneficiaries will be the owners of resort hotels, restaurants and other enterprises, but increased profits will be distributed indirectly to the entire community through taxation and other civil means.

## 2.7 Project Evaluation

### 2.7.1 Affordability Analysis of the Project

Affordability of public investments includes (i) affordability at the sector level, and (ii) affordability at the project level. With regard to the macro-front of the coastal protection and rehabilitation scheme in the Romanian economy (former element), there are readily available of external public funds for collaborative effort for the country's socio-economic development, with the EU post-accession fund as a forerunner in particular. Besides, the World Bank newly approved the Municipal Services Project to MoEWM for the development of environment protection-related infrastructure in pilot eleven counties, in line with the newly coming *Country Partnership Strategy 2007-2009*, following the Environment Management Project of US$150 million in 2005 as the possible financing sources. Further, financing from the Council of European Development Bank (CDB) would be within the realm of possibility, while considering the Bank's preferential support extended thus far to Romania. Likewise, the state government has a medium-term rolling budget program for coastal protection over the forthcoming three years of 2007-2009, with US$157.8 million in aggregate as an indicative fund package for the sector as listed in Table 7.2.1.

On the micro-side of affordability, the Coastal Protection and Rehabilitation Project at Mamaia Sud and Eforie Nord constitutes a part of the pipeline projects for EU post-accession financing within the operational framework for ESOP. Further, the uprising revenue and associated financial position of the project beneficiary – DADL, as reflected in **7.2.2 (3)**, is favorable for implementing operation and maintenance works on their own financial basis.

### 2.7.2 Economic Analysis of the Project

Economic analysis of the Project has duly been undertaken with the economic internal rate of return (EIRR) as the efficiency measurement index. The economic costs of the components "A" (Mamaia Sud), "B" (Eforie Nord), and "A+B" (the aggregate) are estimated at 11.0 million Euro, 27.3 million Euro, and 38.3 million Euro, in that order, with the breakdown by cost component as summarized in Tables ES.1 to ES.3.

As for the economic benefits, the following items have been quantified:

(i) People's welfare as perceived by the presence of beaches on a sound basis (use- and non-use value) – Willingness-to-Pay (*WTP*),
(ii) Foreign exchange (FX) earned in association with the incremental beach areas and expatriate tourists to the region,
(iii) Foreign exchange saved due to the prevention of downsizing expatriate tourism to the region associated with beach preservation, and
(iv) Social costs saved, attributable to the prevention of the collapse of promenade and cliff revetment on the beach.

The amount of WTP is estimated at 21.8 Euro per year per household (2.8 persons on average) on the basis of interview survey with 449 interviewees. The WTP population specifically attributable to the present project at Mamaia Sud and Eforie Nord is presumably set at around 435,000 in compliance with the estimated numbers of check-in tourists and day-visitors to the concerned beaches. This item yields the benefit of 3.1 million Euro per year at maximum.

The second item of the increase of foreign exchanged is estimated as 0.3 million Euro per year at maximum in aggregate of the two components. The third item of the foreign exchanged saved is evaluated as 1.5 million Euro per year at maximum. The fourth item that is applicable for Eforie Nord is estimated as 0.1million Euro for the period from 2007 to 2017 and 0.5 million Euro afterwards.

With these economic costs and benefits, EIRR is calculated as 20.6% for the Component "A" at Mamaia Sud, 7.8% for the Component "B" at Eforie Nord as, and 9.7% for the Project aggregate of "A" and "B." Sensitivity analysis has also been presented.

The proposed project in aggregate reveals economic feasibility at 9.7 percent. With this, the proposed project deserves implementation in terms of the efficient allocation of scare resources in the Romanian economy. In other words, the Project would be likely to be the investment opportunity at a margin, given that the economic return attributable exceeds the economic foregone loss accrued. The Economic Net Present Value (ENPV) in aggregate of the two subcomponents stands at 13.7 million Euro (US$ 17.4 million) at the social discount rate (SDR) of 8 percent.

## 2.8 Operational Framework for and PIU of the Project

The Project of coastal protection and rehabilitation at Mamaia Sud and Eforie Nord is going to need to be financed by external sources to the extent possible such as the EU Cohesion Fund. The project will involve a number of governmental ministries, agencies and other institutions such as listed below.

i) The Ministry of Public Finance (Certifying Authority),
ii) The Ministry of Environment and Water Management (Managing Authority),
iii) Regional and Local Environment Protection Agency (REPA/LEPA) as Intermediary Body
iv) Water Department Dobrogea Litoral (DADL) as Final Beneficiary,
v) Project Implementation Unit (PIU) under DADL,
vi) Consultant group attached to MoEWM and closely work with PIU, and possibly MoPF in the light of procurement procedures,
vii) Steering Committee (an off-line advisory board), and
viii) Supreme Audit Institution as Auditing Authority

In close consultation and discussions with the Romanian counterpart officials as well as those at the European Commission Delegation to Romania, the idea on the possible framework and scheme for project management and implementation has substantially been brought about as shown in Fig. 2.5. The Ministry of Public Finance is a "final certifying authority" in charge of financial management and settlements (payments), and the Ministry of Environment and Water Management acts as the managing authority. The Regional and Local Environment Protection Agency (REPA in Galati/LEPA in Constanta) are placed as "intermediary bodies" administratively responsible for project management and the part of fund management with procurement procedure in particular. The final beneficiary is DADL, within which the Project Implementation Unit (PIU) is set up. Indicative TORs for the above ministries, agencies and institutions are respectively given in **8.3.1**.

PIU is proposed to be composed of around eleven professional staff supported by secretaries and workers. The staff is to be full-time assignment having been recruited outside sources with the Project fund. Indicative TOR for PIU is given in Appendix J.

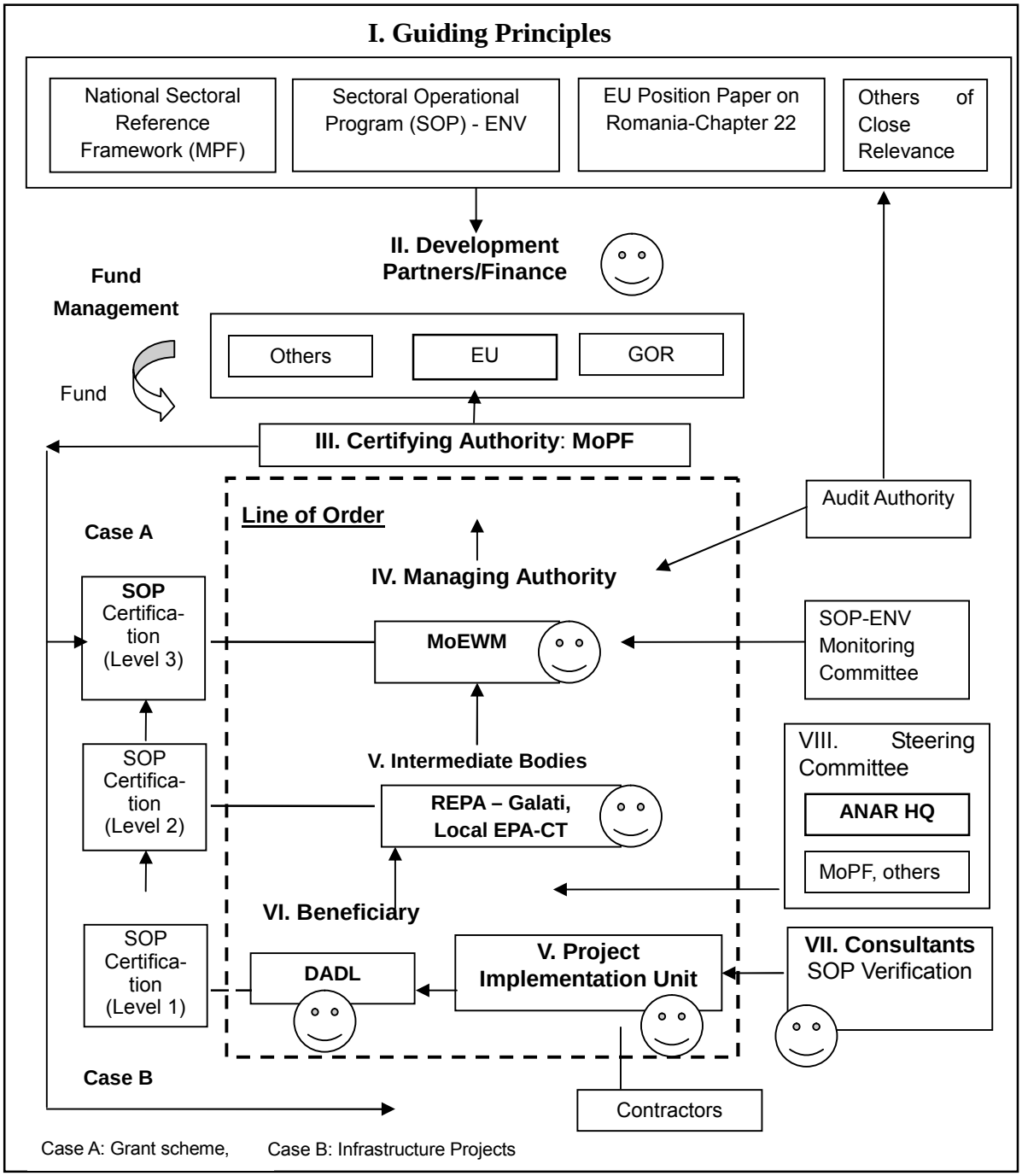


Fig. 2.5: Schematic framework for project implementation

## 2.9 Recommendations and Further Issues

A set of twelve recommendations are made for the project before, during, and after the implementation as listed in **9.2**. The Study team wishes that they will be duly followed by the Romanian side.

A scenario has been drawn for the start of the coastal protection and rehabilitation project at Mamaia Sud and Eforie Nord. Preliminary designs of shore protection facilities are presented with the execution schedule and cost estimate. Affordability of the fund for the project is acknowledged, and economic analysis yields the economic internal rate of return (EIRR) at a value of 9.7 percent. Operational framework of the project is set in close consultation with the Romanian government officials concerned, and the function and framework of the project implementation unit (PIU) are prescribed.

During the public debate of the SEA procedure on the coastal protection and rehabilitation plan of the Southern Romanian Black Sea shore, which was held on March 29, 2007 (the number of participants was 49 including 19 numbers related to the Study) at the National Institute for Marine Research and Development in Constanța, several questions and opinions were raised regarding the Master Plan. Among them, the followings are the main opinions:

- Consultations with and approval from the local community (especially the fishermen) and owners are needed.
- Transport of sand by dump trucks on road may cause significant environmental impact. The methods of transport by water should be studied and examined.

Due to the decision of Romanian government on the application of Strategic Environment Assessment (SEA) to the Study in March 2006, SEA was carried out during the feasibility study, though SEA needs to be conducted prior to the feasibility study according to the processes stated in Romanian SEA as well as JICA's guidelines for the environmental and social considerations. Appropriate measures were needed to be taken to comply with the operational procedure of SEA. For this reason, the Romanian proponent first prepared the coastal protection and rehabilitation plan as well as a draft SEA report based on JICA's pre-draft final report of the Study. Then, the proponent held a public debate on the plan and a draft SEA report in accordance with the Romanian SEA procedure. The outcome of the public debate was included in the final SEA report.

Meanwhile, JICA provided necessary assistance to the Romanian proponent for producing the draft SEA report. Specifically, JICA revised its pre-draft final report by reflecting the outcomes of the public debate so that the revised report could be used by the proponent as the basis for the final SEA report. Appraisal of the final SEA report was completed by the Environmental Management Bureau. After that outcomes of the public debate have been incorporated in this final report of the Study.

In preparation of EIA application documents and execution of EIA procedures in future, it is recommended to pay due considerations to outcomes of public debates and other relevant matters.

## 2.10 Appendices

The Volume 2 of the present Draft Final Report contains the following seven appendices:

Appendix A: Statistics of Seaside Tourists
Appendix B: Regional Economy of Constanța County
Appendix C: Sediment Grain Size Characteristics at Project Site and Beach Fill Sand Sources
Appendix D: Survival Rate of Fill Sand on Beach
Appendix E: Execution Schedule with Bills of Quantities
Appendix F: Beach Monitoring Program
Appendix G: Wave Measurement Record
Appendix H: Discussion on Economic Internal Rate of Return of Environment Sector Project
Appendix I: Indicative TOR for PIU and FIDIC Contracting Method

# PART 3

# ANNEXES

# PART 3 ANNEXES

The Volume 3 of the present Draft Final Report contains the following eleven annexes, which list various data and information related to the Study. It is expected that these annexes will assist planning and execution of the forthcoming coastal protection and rehabilitation projects in the Romanian Southern Black Sea shore.

**Annex A: Aerial and Onshore Views of Study Area** (60 pages)

Listed here are the eighty four photographs of the coastal area from Midia to Vama Veche taken from a helicopter and the thirty six photographs catching the conditions of beach utilization during summer. A table of an estimate of beach visitor density is also presented.

**Annex B: Legal Framework and Public Finance Management in Romania** (10 pages)

This annex briefly describes legal aspects of environment protection, legislative procedure stipulated in the Constitution, public finance management, and institutional framework related to coastal protection in Romania.

**Annex C: Integrated Coastal Zone Management in Romania** (4 pages)

Legal framework of the integrated coastal zone management in Romania and the National Committee of the Coastal Zone are briefly introduced. The minutes of the three meetings of this committee are summarized here.

**Annex D: Physical and Environmental Conditions** (44 pages)

Description of the geological and geomorphological features of the Study area is first made, and then the background data on winds, water level, wave climate, and design waves corresponding to the description in Volume 1 are presented. Results of coastal reconnaissance are described in detail.

**Annex E: Beach Morphology and Prediction of Shoreline Changes** (116 pages)

The first half of this annex is a presentation of the shoreline change data based on the collected topographic surveys, the regression diagrams of all the beach face survey data, and the cumulative distribution curves of grain sizes of the sediment samples taken at the foreshore of the Study area. The latter half of this annex presents the information used for the prediction of future shoreline change, which includes the analysis of the beach sand volume change, the methodology of shoreline change simulation, estimate of the alongshore sediment transport in the Study area, and the design of beach fill plans at Mamaia and other beaches

**Annex F: New Facilities for Shore Protection and Rehabilitation** (16 pages)

Plans and standard cross sections of the coastal protection facilities proposed in the original coastal protection plan for the whole area are presented together with the

conditions for estimate of construction cost.

**Annex G: Environmental and Social Considerations** (88 pages)

Supplementary information of the initial environmental assessment is described over 31 pages. Data of the seven stakeholder meetings such as the subjects of discussion, lists of participants, and minutes of discussions are also presented. Results of environmental examination in the basic study stage are discussed too.

**Annex H: Analytical Frameworks for Financial and Economic Analyses of Development Projects** (7 pages)

This annex explains the basic framework for execution of the financial and economic analyses that was adopted by the Study team, and describes the theoretical background of public service pricing and economic benefit evaluations

**Annex I: Economic Analysis of Priority Projects and Willingness-to-Pay (WTP) Study** (66 pages)

The analytical framework for the economic analysis of priority projects is explained first and then the details of the interview study on the willingness-to-pay (WTP) are presented. Samples of questionnaire for the interview are shown with the method and result of the questionnaire analysis.

**Annex J: Study Mission** (65 pages)

The information related to the execution of the Study is described. Included here are the study items, the study schedule, lists of the Study team members, JICA supporting committee members and JICA staff and Romanian counterparts, copies of the Scope of Works and its minutes signed by the Japanese and Romanian representatives, copies of the minutes of seven meetings of the Steering Committee, records of workshops and seminars, technical transfer on wave observation method, etc.

**Annex K: Views of Existing Shore Protection Facilities** (65 pages)

Photographs of all the existing shore protection facilities in the Study area are listed here with their location maps.

**Annex L: Database in CD-ROM** (5 pages)

Various documents, reports, numerical data, drawings, and other information collected during the execution of the Study are sorted in a form of digital data and are recorded in the attached CD-ROMs.

# APPENDIX

# Appendix A: Advisory Committee, Study Team and Field Study Schedule

## A.1 Formation of Study Team

### (1) Advisory Committee

The Advisory Committee of JICA is composed of three (4) experts and their names and organizations are listed below.

| Name | Assignment | Affiliation[1] |
|---|---|---|
| Mr. Junji YOKOKURA | Chairman | Senior Advisor to the Director General, Global Environment Department |
| Mr. Kazunori WADA | Coastal Protection and Management Plan | Director, Planning and Research Administration Department, Public Works Research Institute |
| Mr. Yoshiaki KURIYAMA | Coastal Erosion | Head, Littoral Drift Division, Marine Environment and Engineering Department Port and Airport Research Institute |
| Mr. Ken-ichi TANAKA | Environment and Social Considerations | Senior Advisor, Japan International Cooperation Agency |

### (2) Study Team

The Team for execution of the Study is composed of six (6) experts and one (2) coordinators, whose names and assignments are listed below.

| Name | Assignment |
|---|---|
| Mr. Yoshimi GODA, Prof. | Chief Consultant / Shore Protection Planning |
| Mr. Yutaka OCHI | Deputy Chief / Natural Condition Analysis |
| Mr. Yuji HATAKEYAMA | Environmental and Social Aspect |
| Mr. Takao OZAKI | Socio-economic Analysis / Operation and Management Planning |
| Dr. Keiji KUROKI | Sedimentation Survey and Analysis |
| Mr. Makoto NAMATAME | Shore Protection Facility Planning and Design |
| Mr. Yoshimasa ITO | Coordinator of first to third on-site study |
| Mr. Yoshiyuki UNO | Coordinator of fourth and fifth on-site study |

[1] Affiliation refers to the position and organization in 2005.

## A.2 Romanian Counterparts

The following personnel[2] of the Romanian side have cooperated with the Team for execution of the Study:

### (1) Ministry of Environment and Water Management (MoEWR)

Ms. Lucia Ana Varga, Secretary of State
Mr. Gheorghe Constantin, Director
Mr. Dumitru Dorogan, Counselor
Ms. Niculina Pop, Advisor
Ms. Andreea Stancu, Advisor
Ms. Iuliana Ionescu, Assistant Advisor
Mr. Silviu Stoica, General Director, Foreign Grant

### (2) National Administration of the Romanian Waters (Apele Romane)

Mr. Madalin Jorj Mihailovici, Director General
Mr. Aurel Panã, Former Director General
Mr. Petru Serban, Director, River Basin Management Plan
Ms. Boscornea Corina, European Integration and Cooperation Department
Mr. Lucian Dumitru, Counselor

### (3) Dobrogea Litoral Water Directorate, Constanța

Mr. Ionel Manafu, Director General
Mr. Gheorgeh Babu, Technical Director
Mr. Andrei Antohi, Counselor
Ms. Camelia Dumitrache, Director
Mr. Dacian Teodorescu, Hydrological Station
Mr. Stelica Hagi, Chief of Investigation Section
Ms. Irina Popescu, Authorization Notification
Mr. Stelian Pascale, European Integration
Mr. Gabriela Marin, Exploitation Section
Ms. Mariana Pitu, Head of Marketing Office
Ms. Madalina Nesan, Accounting Office
Mr. Kertesz Laurentiu, Hydrology and Hydrogeology
Mr. Silviu Matei, Hydrological Station Marine
Mr. Adrian Chera, Hydrological Station

[2] Affiliation of the personnel refers to the position and organization in 2005.

## A.3 Field Study Schedule

Five times of the on-site survey were conducted as followings.

| On-site Survey | Period |
|---|---|
| First On-site Basic Study | May 8 to July 6, 2005<br>July 31 to August 19, 2005 |
| Second On-site Basic Study | October 9 to December 17, 2005 |
| Third On-site Basic Study | February 25 to March 16, 2006 |
| Fourth On-site Basic Study | May 14 to July 7, 2006 |
| Supplementary Study | August 16 to August 25, 2006 |
| Supplementary Study | January 15 to 24, 2006 |
| Fifth On-site Basic Study | February 27 to March 18, 2007 |

Series of steering committee has been held during the field study as in the following.

| | |
|---|---|
| First Steering Committee: | May 18, 2005 |
| Second Steering Committee: | November 4, 2005 |
| Third Steering Committee: | December 15, 2005 |
| Fourth Steering Committee: | February 28, 2006 |
| Fifth Steering Committee: | May 29, 2006 |
| Sixth Steering Committee: | August 22, 2006 |
| Seventh Steering Committee: | March 13, 2007 |

Nine stakeholder meetings in total have been held during the field study, six times at Constanța and three times at Bucharest respectively as in the following.

| | |
|---|---|
| First Stakeholder Meeting (1st at Constanța) | June 15, 2005 |
| Second Stakeholder Meeting (1st at Bucharest) | June 17, 2005 |
| Third Stakeholder Meeting (2nd at Constanța) | November 2, 2005 |
| Fourth Stakeholder Meeting (3rd at Constanța) | November 24, 2005 |
| Fifth Stakeholder Meeting (2nd at Bucharest) | November 25, 2005 |
| Sixth Stakeholder Meeting (4th at Constanța) | March 10, 2006 |
| Seventh Stakeholder Meeting (5th at Constanța) | June 6, 2006 |
| Eighth Stakeholder Meeting (6th at Constanța) | March 9, 2007 |
| Ninth Stakeholder Meeting (3rd at Bucharest) | March 12, 2007 |