

JAPAN INTERNATIONAL COOPERATION AGENCY
THE SOFIA GREATER MUNICIPALITY, THE REPUBLIC OF BULGARIA

THE STUDY ON
THE SOLID WASTE MANAGEMENT FOR
THE TERRITORY OF
THE SOFIA GREATER MUNICIPALITY

FEASIBILITY STUDY MANUAL

July 1994

Yachiyo Engineering Co., Ltd.
Tokyo, Japan

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JR
94-076(9/8)

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1. Objective and Applicable Scope of This Manual

1.1 The Objective of This Manual

This manual describes the principles of the feasibility study (F/S) for solid waste management improvement projects, including survey methods and standard of reporting. This manual is prepared based on the JICA Study experience gained in the solid waste management study of Sofia Greater Municipality.

It is expected that this manual will be used in Sofia or other cities of Bulgaria as a guide when carrying out a feasibility study of solid waste management improvement projects. Also, it is expected that this manual will contribute to the successful execution of a feasibility study fulfilling all the requirements and to improvement in the quality of feasibility studies.

(1) Feasibility Study

The Feasibility Study (F/S), is a study, the primary purpose of which is to define the feasibility of implementing future projects. For this purpose:

- a. It is necessary to decide upon the projects to be studied before commencement of the feasibility study. The minimum requirement is to define the frame work of the projects to be studied.
- b. The securing of sites for solid waste facilities such as disposal sites is a precondition for the implementation of projects. Solid waste facilities are considered to be nuisance facilities, and as such, acquisition of land for such facilities is usually difficult, so it is desirable that site selection and securing of site is definite prior to commencement of the F/S.
- c. It is necessary to heed the fact that the content and amount of work of the F/S will vary according to the type of project and its locational conditions. Also if the scope of the study is widened, it is natural that the number of surveys and examination items will increase, and that the time period and cost of F/S will also increase.

(2) The procedure of F/S is described in paragraph 2.2.

1.2 The Applicable Scope of This Manual

This manual was prepared for the F/S of solid waste management improvement projects.

(1) Characteristics of Solid Waste Management (SWM)

It is necessary to bear in mind the following characteristics of SWM projects:

- a. SWM is an activity indispensable for preservation of public sanitation and the environment of cities.
- b. In various areas within Bulgaria, SWM is already being carried out by autonomous bodies. Accordingly, most of projects to be implemented will be improvement projects rather than new projects. Consequently, it is extremely important to identify the problems encountered by current SWM and to clarify those to be solved through implementation of the project. Projects shall be formulated along those lines.
- c. With regard to new projects, it is also necessary to give due consideration to the relationship between the new system and the system currently in use.
- d. Among the benefits resulting from SWM improvement projects, benefits which are difficult to quantitatively assess are large in number, so this point should be considered along with a stressing of financial evaluation when evaluating projects.
- e. In general the land acquisition for disposal sites is difficult.
- f. SWM is one of the public services provided by municipal authorities, so it is necessary to establish a strong financial base to provide efficient and continuous services.

When carrying out the F/S for SWM projects, the following points must be taken into consideration.

- a. The adjustment of service levels to appropriate levels.
- b. Emphasis should be placed on minimum cost projects.
- c. Due weight should be given to financial evaluation within the overall project evaluation.

(2) Relevant Legislation as of January 1994

The Bulgarian Legislation pertaining to SWM and the environment is listed below. However legislation is currently undergoing improvements, so changes in regulations should be checked when this manual is used.

- a. Draft Waste Act
- b. Regulation on cleanness of settlements
- c. Regulation on hazardous waste
- d. Regulation on design of sanitary disposal site for solid household waste (SWH)
- e. Instruction for design and running of sites for controlled deactivation of SWH
- f. Instruction for separate collection of SWH
- g. Methodical guidelines for collecting and transport of SWH from populated areas
- h. Methodical guidelines for design of organization of SWH collection and transportation
- i. Public health law
- j. Regulation on the application of the public health law
- k. Environment Protection Law
- l. Regulation on the environmental impact assessment

Furthermore, in addition to local autonomous laws, the acquisition and usage of facility sites must strictly confirm to the relevant legislation.

1.3 Technical Terms used in This Manual

The meanings of the various technical terms used in this manual are as follows;

- | | |
|-----|---|
| F/S | A study to clarify the feasibility of implementing a project. The objective and content of the study, in addition to the study method, are all indicated in this manual. |
| SWH | This term describes general municipal waste, and in Bulgaria is defined by the Draft Waste Act to include household waste, commercial waste, and waste similar to household waste. It does not include industrial waste or hazardous waste discharged from manufacturing processes. |

Economic evaluation

This evaluation is generally carried out from the viewpoint of the national economy. A cost benefit analysis is usually used as the form of analysis. The economic benefits and the economic costs are calculated using economic value that may be different from market prices in some cases, as shown in the following items.

- a. Taxes and other transfer values are not considered.
- b. When market prices include subsidies in a country, international prices are used.
- c. Economic values shall take into account the level of unemployment and other current national indicators.
- d. There are many items of benefit which may not be quantified in SWM project. But it is necessary to incorporate these unquantifiable benefits into the economic evaluation.

Sanitary landfill

The definition of sanitary landfill is not uniform, but is generally understood to apply to landfill methods which fulfill the following conditions.

- a. Be a solid waste disposal site and having explicitly designated boundaries.
- b. Control of hauled in solid waste and landfill operations
- c. Utilization of cover soil
- d. Impermeable liner, collection and treatment of leachate practiced.
- e. Gas removal
- f. The implementation of other required environmental protection measures.
- g. The provision of facilities, machinery and materials, and staff to carry out landfill operation.

2. Objectives and Procedure of the Feasibility Study

2.1 Objectives of the F/S

(1) Objectives

The F/S is a study to be implemented to achieve the following four objectives

- a. To clarify the feasibility of projects to be implemented.
- b. To establish an appropriate project plan to enable implementation with ease.
- c. To create sufficient documentation to enable obtaining the understanding and agreement of city mayors, concerned authorities and general public, as well as the providers of funds.
- d. To establish an implementation program for feasible projects.

(2) Feasibility of Projects

Feasibility of projects is evaluated from technical, financial, economic, environmental and social aspects. Feasible projects are those projects which fulfill the conditions listed below.

- a. Technical system is sound and suitable.
- b. Land acquisition is feasible.
- c. There are no legal problems.
- d. Environmental impact assessment is favorable.
- e. The agreement of those concerned is obtainable.
- f. Funding is feasible.
- g. Securing of skilled staff is feasible.

2.2 Procedure of F/S

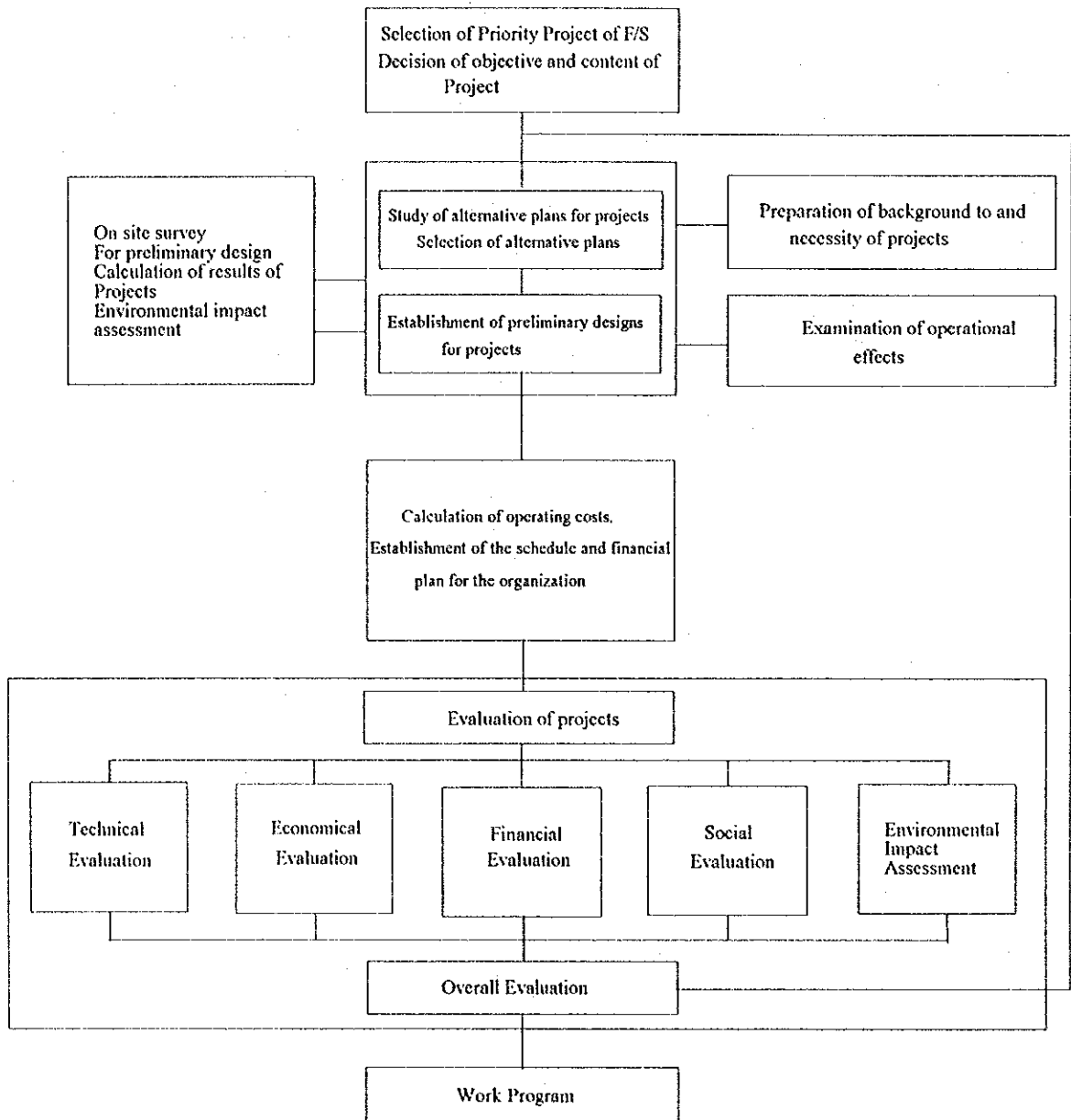
The procedure for the F/S is shown in general terms in Figure 1.

2.3 F/S Report

The F/S Report shall provide the basis for the decision making of the mayors and concerned authorities, as well as the banks or other organizations which act as the provider of funds, and as such the report should be comprehensive. It should be prepared according to the following items.

1. The background to, and necessity of implementing the project.
 2. The objective and framework of the project.
 3. Project operation plan.
 4. The project cost and implementation schedule.
 5. Financial plan for implementation and operation
 6. Effect of project.
 7. Evaluation of project.
 8. Implementation program.
-

Figure 1 F/S Work Flow



3. Selection of Project to be studied

From amongst the various SWM projects, it is necessary to select those projects providing urgently required improvements and are deemed to have a large beneficial effect. Consequently, priorities should be assigned to the various projects considering social demand and financial capabilities, and the projects with high priority should be selected as the projects for F/S. Further, it is necessary that the selection and securing of sites for the project is feasible.

(1) Stepwise Approach to SWM Improvement

Solid waste management is basically improved step by step. An example of stepwise improvement is shown in Figure 2. Under the Bulgarian Draft Waste Act, sanitary landfill, recycling, and the appropriate treatment of hazardous household waste are pursued. Accordingly, it may be considered that Steps 4 or 5 cover the demand of the society.

Figure 2 Steps of Improvements to Solid Waste Management

Step 1	Waste collection (removal of waste from municipal areas)		
Step 2	Waste collection and controlled final disposal		
Step 3	Waste collection and sanitary landfill		
Step 4	Waste collection, appropriate treatment and sanitary landfill	Waste collection, recycling and sanitary landfill	
Step 5	Improvement of appropriate treatment	Appropriate treatment and recycling	Improvement of recycling
Step 6	Recycling, improvement of appropriate treatment and sanitary landfill		

(2) Requirement for the projects to be studied in F/S

The project shall have priority as mentioned before. The projects usually require investment. Therefore, it is not sufficient that projects be economically beneficial, they must also be technically and financially feasible. In addition, there must be no significant impact on the environment, and they must be socially acceptable.

(3) Method for Selection of the Project for F/S

As a method for the selection of the project for F/S, it is desirable that a master plan (M/P) regarding SWM be established, and priority given to those projects according to the phased implementation program proposed in that M/P. In doing so, not only will a long term double investment be avoided, but also long term planning and necessary conditions related to the project will be clarified.

For example, taking the case of the purchase of additional collection vehicles to cover shortage of collection vehicles, as the useful life of vehicles is 5-10 years, the planning of conditions to enable the vehicles to be used appropriately for the duration of that period is necessary to evaluate their economical efficiency and other items. However, the securing of disposal sites for SWM is difficult in many cases, and there are many instances where it was only possible to secure disposed sites with only a few years capacity. These conditions shall be checked. There are also cases where the appropriate type of vehicle is influenced by the location of the disposal site, so it is desirable that in these cases inclusion of extension or construction of disposal site in the project for the F/S will be required.

(4) F/S Project for the Sofia Greater Municipality

The M/P for the Sofia Greater Municipality Study was established under the JICA Study and the following priority projects were deemed to be necessary to be carried out by the year 2000.

- a. Improvement of collection and haulage.
- b. Construction of new disposal site
- c. Recycling pilot project
- d. Restructuring of SWM organization
- e. Revision of tariffs for waste tax and charging fees

(5) Site Selection

Facilities for SWM, for example disposal sites, are nuisance facilities, and as such, the securing of sites for such facilities is generally difficult. As a result, it is desirable that prior to the carrying out of F/S, site selection and securing of the site be confirmed. In the case that site selection is carried out during the work of F/S, study contents and schedule shall be carefully examined considering necessary process of environmental impact assessment and other relevant process to obtain the agreement of residents of the surrounding areas.

4. Field surveys required for the F/S

In order to implement the F/S, the following field surveys will be required.

- a. Surveys for preliminary design
- b. Surveys required for the calculation of the effects of projects.
- c. Surveys required for the environmental impact assessment.

Appropriate project plan shall be established during the F/S together with estimation of project cost. Since financial plan will be prepared based on this cost estimation, necessary field surveys shall be carried out to estimate project cost with sufficient degree of accuracy. In addition, there is also a need of field surveys to calculate the effects of projects and to conduct the environmental impact assessment. Further, the study items required in the environmental impact assessment are defined in the Bulgarian Legislation.

(1) Surveys for Preliminary Designs

For projects with facilities construction, preliminary design is required. Usually site topographic and geological surveys shall be carried out.

(2) Studies Required for the Calculation of the Project Effects

Studies required for the calculation of the project effects must be carried out bearing in mind the components and particular conditions of the projects to be studied. Especially the "without project" case (the project is not implemented) shall be carefully studied for comparison with the "project" case (project is implemented). It is desirable to include comparison of the costs between the "project" case and the "without project" case.

(3) Studies Required for Environmental Impact Assessment

The environmental impact assessment required in Bulgaria is regulated by the EIA Legislation. The content of the environmental impact assessment is as shown in Annex 2: air; water; soil; flora and fauna; soil; health safety; social economy; and culture. An evaluation of the impact of projects on the above is required. In practice, it is necessary to consider the extent of project impact to decide the survey scheme. It is a matter of course that the items should be emphasized due to the type of the project.

(4) Field survey of the Sofia Greater Municipality Study (Example)

The content of the surveys required for the F/S change according to the type of project and the local situation. As components of the Sofia Study, the following surveys were carried out at the selected future disposal site.

Disposal Site	Topographic Survey Scale 1:1000
Survey	Geological Survey and Groundwater Study (Boring and soil analysis, groundwater sampling and analysis, groundwater levels, etc.)
Environmental	Ecological Survey
Surveys	(Flora and fauna)
	Water Quality Survey of Area Surrounding Disposal Site (Identification of nearby water bodies, sampling and analysis)
	Noise Level Survey
	Land Use Survey
	(Population, residential, commercial, industrial activity around the site)
	Air quality

5. Preliminary Designs

The objective of the preliminary designs is to define the content of the projects to be implemented. The cost will be calculated based on these designs. For this purpose, the preliminary designs must clarify the following items.

- a. The system to be introduced .
 - b. A description of the facilities, machinery and materials required for the project.
 - c. Operation and maintenance plan including personnel required.
-

(1) Improvements to Collection

Projects to improve collection must be examined on the following points.

- a. Level of service and service area.
- b. Collection system.
- c. Machinery and materials required, collection vehicles and containers etc.
- d. Working plan
- e. Personnel

(2) Final Disposal Site

The following points must be examined in the construction of final disposal sites.

- a. Plan of type and amount of solid waste to be disposed of
- b. Disposal method Sanitary landfill
- c. Environmental protection plan
- d. Preliminary design for facilities Impermeable liner
 Landfill site
 Leachate collection facility
 Gas removal facility
 Leachate treatment facility
 Receiving facilities
 Storm-water drainage facility
 Fences
 Approach road
 Control room, etc.

- c. Sanitary Landfill Operation plan Disposal of Waste
Cover soil and borrow pit
- f. Machinery and materials Heavy machinery etc.
- g. Personnel

(3) Recycling

When a recycling pilot scheme is carried out, the following points must be examined.

- a. Scale and scope of the pilot scheme.
- b. Items to be recycled, separation method, and volume to be recycled.
- c. Recycling method Method of discharge
Storage and separation
Collection method
Buyer of the material
- d. Necessary machinery, materials and facilities
- e. Personnel

(4) Restructuring of SWM Organization

The following items must be examined for reorganization scheme.

- a. Responsibilities Relationships and allocation of responsibilities
between national and municipal authorities, and
executive organization of solid waste management
- b. Type of organization
- c. Organization structure
- d. Duties and personnel of each division

(5) Revision of waste tax and service charge

The following items must be examined for revision scheme of solid waste tax and service charge to increase revenues and fairly distribute the burden.

- a. The charging system and fee collection method.
- b. Tariff of waste tax and service charge.
- c. The potential revenues, and the extent of the burden placed on residents and businesses.

6. Alternative Plans for Projects

In order to select the most appropriate projects to be implemented, alternative plans should be examined. Especially in the case of large scale projects, the examination of phased implementation may be necessary. Alternative plans examination will clarify the following items which are important for preparing the financial plan and project evaluation, in order to determine the most appropriate plan.

- a. What scale of project will be most appropriate
 - b. When should the projects be implemented.
-

(1) Cases Requiring Alternative Plans

In the case where projects have been deemed necessary but seem to be unfeasible, cases exist where the scale of projects may be too large, the implementation period too soon, or the many other demands of society may overwhelm the financial capabilities of the government. In these cases, the project plan formulated in the preliminary design shall be revised to make it feasible. Also it may be necessary to incorporate into a project plan proposals which resolve the constraining factors.

(2) Alternative Plans for the Sofia Greater Municipality Study

In the Sofia Greater Municipality Study, the suggested projects were deemed to be feasible provided the land for the disposal site may be secured. Unfortunately, it was judged that agreement regarding the selected disposal site would not be obtainable in the near future. As a result, an alternative plan incorporating environmental protection measures into the existing disposal site was suggested, but the costs of such an alternative plan exceeded those of constructing a new disposal site on the planned site. In addition, approval was not reached with those concerned regarding the continued use of the existing site.

7. Calculation of Costs and Financial Plan

- a. It is necessary that costs be calculated separately as investment costs and operation and maintenance costs.
- b. In the case that loan for financing is provided by a foreign bank, the investment costs should be calculated divided into foreign and local currency portions.
- c. The local and foreign portions of the cost are estimated based on the following considerations;

(a) Foreign portion

- | | |
|---------------------|---|
| - Construction work | Machinery cost of construction |
| | Material cost (Foreign product) |
| - Equipment cost | Equipment purchase cost (Foreign product) |
| - Consultant cost | Foreign expert cost |

(b) Local portion

- | | |
|---------------------|---|
| - Construction cost | Personnel cost |
| | Material cost (Local product) |
| - Equipment cost | Equipment purchase cost (Local product) |
| - Consultant cost | Local expert cost |
-

(1) Investment Costs

Investment costs usually include the following costs. Further, there is a need to calculate the initial investment of facilities, machinery and materials separately from renewal investment.

- Facility construction expenses
- Costs of purchasing vehicles, machinery and materials

(2) Operation and maintenance costs

Operation and maintenance costs are comprised of the following costs. Operation and maintenance costs must be raised by internal financing.

- Depreciation expense
- Operating costs
- Personnel expenses
- Maintenance cost
- Consumable expenses including fuel and energy cost
- Other expenses

7.2 Financial Plan

The financial plan for the project shall be prepared to include all revenues and expenses on a yearly basis. Repayment and interest of loan shall be included and clearly defined.

(1) Revenues of Solid Waste Management

a. The following will be the main revenue sources for SWM projects by SWM operator.

Operation by Municipality	Operation by Public Corporation
General Municipal Funds	Municipal Subsidies
Special Municipal Funds (Waste tax etc.)	Municipal Consignment Fees (Waste tax portion etc.)
Waste Service Revenues	Waste Service Revenues
Others (revenues from sales of reusable material etc.)	Others (revenues from sales of reusable materials etc.)

b. As subsidies, waste taxes and service charges make up a large part of the revenues of solid waste management, plans for the collection of waste taxes and charges must be appropriately prepared. It is also necessary that municipal subsidies be within the financial capabilities of the municipality, and that the waste taxes and service charges be within a range affordable by residents and businesses.

c. As municipal solid waste management is indispensable in preserving the environment and public sanitation of the municipality, it is vital that SWM projects shall be financially sound.

(2) Expenses

Expenses of SWM project shall include operation and maintenance costs, interest, and repayments of loan. In addition, in the case of a public corporation, taxes must also be considered

(3) Financial source of investment Costs.

To cover investment costs, loans may be considered as a financial source together with own fund. Foreign loans with favorable conditions should be sought. In using such loans, the future repayments and interest must be taken into account. Consequently, it is desirable that investment costs of collection vehicle and containers that have a relatively short life time are covered by own fund whenever possible.

In the case where foreign loans are utilized, the fact must be heeded that financing conditions vary according to the financing agency. Especially under the circumstances where part of project cost shall be covered by local fund including local loan. In addition, it is necessary to take into account the necessary procedure for application and disbursement of loan.

(4) Financial source of operation and maintenance costs

Operation and maintenance costs shall be covered by own fund. In the case that own fund is insufficient, short term loans may be used to cover the shortage, but this should be avoided in principal.

(5) Financial Plan

A financial plan shall be created based upon the revenues and expenses described above including loan amount and its conditions. In order to ensure that the plan is financially sound, the plan should satisfy the following conditions.

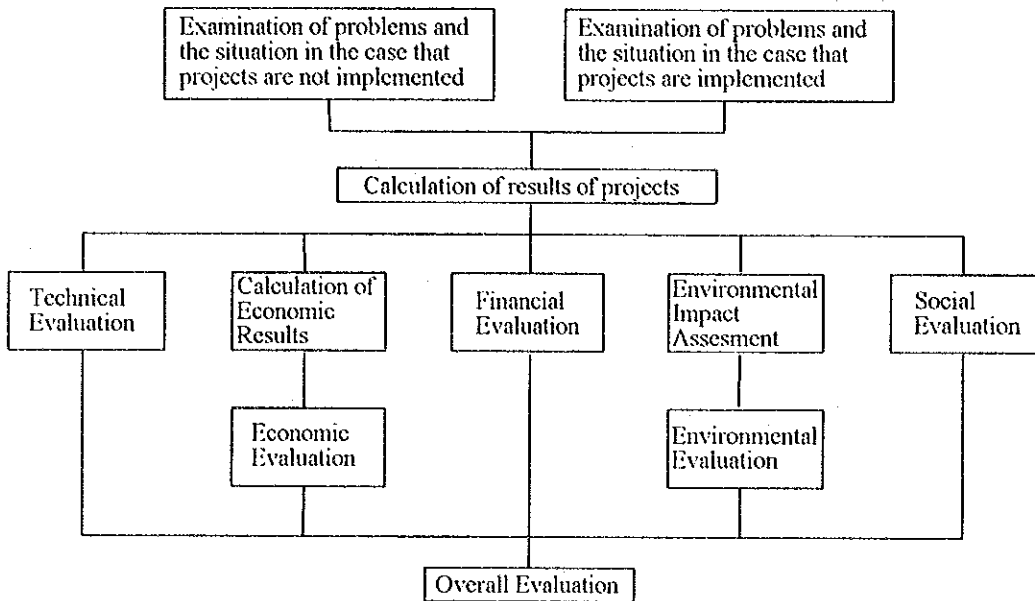
- a. Loan repayments are feasible.
- b. Project continuity (construction and operation) is feasible.
- c. Loan repayments are not over-burdening.

The financial plan proposed in the Sofia Greater Municipality Study is shown in Annex 1.

8. Evaluation of Projects

8.1 General

- a. Evaluation of projects should be carried out from technical, economical, financial, environmental, and social aspects. In addition, an overall evaluation which combines the results of individual evaluations is necessary.
- b. The flow of evaluation work is usually in the following form.



8.2 Technical Evaluation

A technical evaluation must evaluate the following points

- a. Whether the technology used is socially appropriate.
- b. The resolving of technical problems inherent in the existing SWM, and improvement in working conditions.
- c. The adaptation of SWM to future directions in technology.
Recycling, waste reduction, stabilization, improvements in working conditions.
(Environmental improvements shall be dealt with in the environmental evaluation.)
- d. The possibility of securing sites.

(1) Appropriate Technology

Without being limited to SWM, which technology is appropriate is a matter of debate. At the least, it should satisfy the following conditions.

- a. Operation and maintenance is continually possible in terms of personnel and financing.
- b. The securing of necessary spare parts is possible without problems.
- c. Excessive levels of efficiency in project operation are avoided.

(2) Improvements to Working Conditions

It is necessary to recognize the fact that compared with other workplaces, those of SWM are definitely not as safe, and are the scene of many accidents. The fact that the improvement of working conditions is not only a current problem, but also a problem of the future, should be taken heed of. In Japan, improvements to collection vehicles are being pursued to prevent the occurrence of accidents.

(3) Consideration of the Move to Technology of the Future

With regard to recycling, Germany and other West European countries are pursuing legislation to expand recycling as one target of SWM in the future. In addition, the diversity of waste calls for upgrading of environmental protection measure for the disposal sites and sanitary landfill operation, therefore, appropriate intermediate treatment is required. There are also diverse opinions about incineration. These points indicate the problem that treatment cannot be carried out using minimum cost proposals alone (which may only take quantitative benefits into account). As there are various demands from society, project evaluations should be carried out considering the future directions which should be taken.

In the case of Sofia Greater Municipality Study, the implementation of sanitary landfill is deemed to be the first priority for some time, but it was considered that it would be unable to cope with future technological demands and the demands of the society, so a mid to long term incineration facility is considered necessary.

8.3 Economic Evaluation

With regard to SWM projects, as mentioned earlier, these are projects which are absolutely indispensable, and their benefits are largely unquantifiable, i.e. the protection of the municipal environment and public sanitation. These facts should be given due consideration in the economic evaluation. In this case the basic points are as follows.

- a. The minimum level and scope of service required by SWM projects shall be defined.
 - b. Within that scope, the minimum cost plan shall be defined.
 - c. As the projects are indispensable, the minimum cost plan will be feasible in principal.
 - d. The cost currently being sustained by SWM is a necessary cost to be incurred in the future if improvement projects are not implemented. Accordingly, in the case that improvement projects are implemented, the benefit incurred from the improvement project will include the cost which would be required in the "without project" case, and which has now become unnecessary.
 - e. The service level shall comply with the demands of the society. In many cases the demands of society exceed those of the administration, so the service level demanded by society must be treated carefully.
-

(1) Method of Economic Evaluation

The economic evaluation of projects is generally carried out using the cost-benefit analysis method. The cost-benefit analysis must clarify the economic costs and economic benefits of the projects. In addition, in carrying out an evaluation of quantifiable benefits, indicators such as benefit / cost ratio (B/C), net present value (NPV), and internal rate of return (IRR) may be used.

These indicators are broadly defined as follows;

Benefit Cost Ratio : The project benefits (B) and cost (C) are calculated. When B/C ratio exceeds 1.0, this is one indicator that the project may be feasible.

Net Present Value : The present value of a future receipt or receipts, calculated using an interest rate.

Internal Rate of Return : The rate at which the present value of future returns (additional revenues less operating costs) from the project equals the cost of project. For the project to be feasible, internal rate of return should exceed the rate of interest.

(2) Benefits

a. In the case of projects to improve waste collection and transport

The following benefits may be attained by improvement of collection and transportation.

A reduction in costs accompanying improvement of collection.

Improvement in sanitation level of the area together with improved services.

b. In the case of sanitary landfill

Benefits resulting from the introduction of sanitary landfill are as follows.

Improvement in the environment of the areas surrounding disposal sites resulting from the implementation of sanitary landfill.

Final disposal sites are indispensable for SWM. In addition, as environmental protection standards demanded by sanitary landfill become higher, costs rise. As long as the level demanded is appropriate, the increase in construction costs of the necessary final disposal sites will have to be borne by the municipality or by residents. The economic benefits resulting from these increased costs are difficult to quantify, so it is better to put more emphasis on financial evaluation.

c. In the case of construction of transfer stations

The following benefits should be considered in the case of construction of transfer stations.

Reduction in transportation costs.

Stabilization of the collection system.

d. In the case of incineration

The following benefits should be considered in the case of introduction of incineration plant.

Reduction in disposal and transportation costs.

Stabilization of the collection system.

Reduction in the volume of waste disposed of, as well as detoxification and stabilization effect.

Recovery of energy effect.

Excepting cases where cost of final disposal are extremely high, the reductions achieved in disposal cost and transportation costs through introduction of incineration plant will normally be less than construction cost. Accordingly, rather than introduction of incineration plant, sanitary landfill should be adopted if minimum cost plan is selected. However, introduction of an incineration plant has a number of unquantifiable benefits as described above. Therefore the construction of an incineration plant is one project which should be carried out considering demands of residents if it is financially possible.

e. The case where recycling is introduced

The following benefits should be considered in the case where recycling is introduced.

A volume reduction of waste, resulting in a reduction in the costs of SWM.

Revenues from the sale of recyclable material.

Saving in natural resources and raw material resulting in the conservation of environment.

Recycling and reduction in the volume of waste are targets of SWM projects recognized worldwide. However, there are economic problems inherent in the associated scheme. The cost of the recycling scheme may exceed its revenue and the added saving in decreasing SWM cost though volume reduction achieved in the scheme. As a result, it can be said that there is no fixed indicator in determining what level of recycling is appropriate. Accordingly, the only option is to carry out recycling at a financially feasible level.

8.4 Financial evaluation

Financial evaluation is the basis for determining whether SWM projects are feasible or not. In case projects are financially unfeasible, tariff of waste tax and service charges, and burden of municipality shall be examined carefully to make the project feasible. In this case, as an index, the proportion of funds supplied by municipal budget, and the proportion of waste tax and service charge in the income of residents of the area, should be examined carefully, and the burden accordingly to be borne by each shall be evaluated.

Financial internal rate of return (FIRR) is generally used as an important indicator of investment to evaluate the projects. In addition, it is necessary to carry out sensitivity analysis that may demonstrate changes of FIRR through a number of case studies alternating revenues and cost amounts.

(1) Burden on the Municipality and Residents

The limit to the burden placed on the municipality differs by country according to the institutional set up. However, the limit to the burden placed on residents may be considered as 1.0% or less of household income. The SWM system and project shall be established taking into consideration limits of the burdens to be borne by both the municipality and residents.

8.5 Environmental Evaluation

(1) The environmental evaluation required in the F/S has the objective of verifying the environmental suitability of the projects. The environmental study shall have an important impact on making the project operation more efficient and environmentally sound.

(2) As EIA Legislation already exists in Bulgaria, in the case that an environmental impact assessment is carried out based on this legislation, the results of that assessment may be utilized.

A description of the contents of preliminary and final EIA reports is enclosed in Annex 2.

(1) Important points in the EIA Legislation

The formal requirement and procedure of environmental impact assessments are defined in the legislation. In the enforcement of the SWM, it is necessary that those formalities be coordinated with the process of establishing the implementation program. Within the EIA Legislation, the following points should be stressed.

- a. The environmental impact assessment must be carried out by independent experts.
- b. The final decision shall lie with the Department of Environment or the Regional Office for Protection of the Environment.

- c. When the implementation of projects has been authorized, that decision shall be valid for a period of one year.

(2) Environmental Impact Assessment required by the F/S

As the EIA Legislation is present in Bulgaria, almost all projects can be implemented once they have finished formalities for the environmental impact assessment. However, with regard to SWM projects, it is common that the obtaining of residents approval for the securing of the disposal site is the first problem to be overcome, so it is desirable that environmental impact assessment required to get resident consensus be carried out early. With respect to the environmental impact assessment of the F/S, the results of the study should be utilized, to determine the major environmental impacts and evaluate whether or not environmental preservation standards will be maintained.

8.6 Social Evaluation

As social systems differ from country to country, cases exist where although a project may be technically feasible, it may be difficult to be accepted on social terms. It is especially important to establish whether problems exist or not for the acceptance of projects in terms of customs, religions, or racial circumstances. Within solid waste management, the appropriate collection service has a direct link to residents, so a suitable system easily fitting in with the characteristics of the region and readily accepted by its residents is vital.

A large part of solid waste management relies on unskilled labor, so it is an area which requires special consideration in the case that a society faces an unemployment problem. In addition, there is also concern over scavengers and the destitute. Accordingly, projects to be implemented must be qualitatively examined to judge whether or not they are acceptable from a social point of view.

8.7 Overall Evaluation

Using as its basis the evaluations described above, an overall evaluation must be carried out to judge whether or not the project is feasible, identify possible problems in the implementation of the project, and solutions found for those problems. Although there are various proposals regarding the style of the overall evaluation, in reality one aspect of the evaluation may become a neck to the implementation of the project in many cases, so a practical style which takes account of this fact should be utilized.

9. Establishment of the Implementation Program

(1) Content of the Implementation Program

The implementation program must clearly define the executive agency of the project and its organization, project implementation schedule as well as the financial plan.

(2) Executive agency

The executive agency of the project will be different in the case of municipal operation of SWM projects to the case of a public corporation. In any case, in order to implement the project, within the executive agency, a Project Implementation Unit (PIU) shall be formulated to include project manager, expert on finance and engineers required for implementation of the project.

(3) Implementation Schedule

The implementation schedule involves not only the consideration of construction period for facilities and purchase period for machinery and materials, but also the consideration of the time taken for the basic and detailed designs, the tender process, and other matters. In addition, when foreign loan is utilized, the time required for the application and approval formalities must be taken into account, and a reasonable schedule shall be established.

(4) Financial Plan

The financial plan must clearly define the investments required for the implementation of projects, as well as operation and maintenance costs. In addition, if a loan is used for investment, it is necessary to define the repayment schedule.

(5) Training and Education of Residents

The training of staff is imperative in the implementation of projects. Particularly in the case where new technology is introduced, a training plan should be established, to secure the necessary skilled staff.

Furthermore, as the cooperation of residents is indispensable to improve SWM, specially in the discharge of waste, waste separation for recycling, and the burden of charges, a continuous residents education program should be prepared.

ANNEX 1
FINANCIAL PLAN

1. Financial Plan

Inflation is not considered in the formulation of the financial plan of the priority project. Financial plan is prepared for PLC, to be established in 1995.

1.1 Financial Requirement

(1) Investment Cost

Based on the implementation schedule of priority project and cost estimation, total investment cost by year 2000 is shown in Table 1.1-1. The construction of the disposal site is set in year 1995 and 1996. Total investment cost including renewal cost of equipment will be US\$ 51.1 million.

(2) Annual Cost

Operation and maintenance cost to the 2000 is estimated to be US\$ 32.3 million as shown in Table 1.1-2. Beside operation and maintenance cost, interest on loan and profit tax levied on PLC should be taken into account. Amount of interest is estimated based on the condition and amount of loan. PLC shall pay a profit tax that equivalent to 52 % of its profit.

Table 1.1-1 Investment Cost (Unit : US \$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Collection							
Vehicle	0	2,840	4,305	2,865	3,000	2,150	15,160
Container	1,324	109	218	1,421	110	1,452	4,634
Landfill							
Civil Work	2,725	20,694	0	0	0	0	23,419
Mobil	0	2,826	0	0	0	0	2,826
Recycling							
Vehicle	0	0	60	0	60	240	360
Container	0	0	90	0	366	609	1,065
Workshop etc.							
Civil Work	522	2,484	0	0	0	0	3,005
Container	0	600	0	0	0	0	600
Total	4,570	29,552	4,673	4,286	3,536	4,451	51,069

Notes: Total of each row and line has some error because of rounding of figures.

Table 1.1-2 Operation and Maintenance Cost (Unit : US \$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Collection							
Personnel	2,194	1,957	1,859	1,907	1,942	1,977	11,836
Maintenance	1,384	1,244	1,323	1,330	1,210	757	7,248
Others	1,183	989	1,001	1,058	1,084	1,100	6,416
Landfill							
Personnel	89	93	107	107	107	107	611
Maintenance	5	5	0	83	101	136	330
Others	346	360	725	753	503	512	3,200
Recycling							
Personnel	0	0	11	11	16	43	81
Maintenance	0	0	6	6	20	50	81
Others	0	0	3	3	8	22	36
Workshop etc.							
Personnel	96	96	192	192	192	192	960
Maintenance	0	0	12	12	12	12	50
Others	117	117	285	285	285	285	1,376
Total	5,415	4,862	5,525	5,748	5,481	5,192	32,224

Notes: Total of each row and line has some error because of rounding of figures.

1.2 Financial Source

(1) Revenue of Fee Collection

Revenue of SWM consists of waste tax, collection and tipping fee, income through sales of reusable material and subsidy from SGM.

- a. Waste tax shall be collected by SGM and transfer to PLC
- b. Fee for collection and tipping service shall be collected directly by PLC.
- c. Sales of reusable material shall be managed by PLC.
- d. Subsidy from SGM to PLC shall be provided as same amount in 1993 until 1999.

It is estimated as shown in Table 1.1-3. Annual cost shall be covered by this revenue in principal.

Table 1.1-3 Composition of Revenue (1994 Price) (Unit : US \$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Waste Tax							
Household	1,056	1,056	4,106	4,106	4,106	8,409	22,839
Shops etc.	5,583	5,583	5,583	5,583	5,583	5,583	33,498
Collection Fee							
Shops etc.	717	717	1,036	1,142	1,249	1,355	6,216
Tipping Fee	38	38	129	133	137	141	616
Selling of Reusable Materials	0	0	20	21	109	264	413
SGM Budget Allocation	325	325	325	325	325	0	1,625
Total	7,719	7,719	11,199	11,310	11,509	15,752	65,206

Notes: Total of each row and line has some error because of rounding of figures.

(2) Source of Investment Cost

The foreign portion of disposal site cost shall be financed by a loan from an overseas bank under assumed conditions as shown in Table 1.1-4. Loan condition has been set considering ordinary condition of EBRD and IBRD that interest rate will be around 7 % and more for Eastern Europe Countries.

Total local portion shall be financed by domestic banks under the conditions shown in the same table. Remaining investment cost including purchase cost of collection vehicle, container and equipment required for recycling and their renewal cost, and construction cost for adaptation of depots and workshop, and for amenity center shall be covered by own fund. Shortage shall be covered by short term loan from domestic bank. The financial source for investment is shown in Table 1.1-5.

(3) Financial Source for Annual Cost

Annual costs that include operation and maintenance cost, and interest of loan shall be covered by own fund. Shortage shall be covered by short term loan if necessary.

Table 1.1-4 Loan Condition

	Payment Condition	Interest Rate
Foreign Loan	Repayment over 15 years with a 5 year grace period	7.5 %
Local Loan		
long term	Repayment over 10 years with a 3 year grace period	8.5 %
short term	Repayment in the following year	12.5 %

Table 1.1-5 Source of Investment Funds (1994 Price) Unit : US \$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Own Fund	586	912	2,932	2,603	2,769	4,451	14,253
Foreign Loan	2,725	11,547	0	0	0	0	14,272
Local Loan							
long term	522	15,056	0	0	0	0	15,578
short term	738	2,037	1,740	1,684	768	0	6,966
Total	4,570	29,552	4,673	4,286	3,536	4,451	51,069

Notes: Total of each row and line has some error because of rounding of figures.

1.3 Financial Plan

Based on the above mentioned financial requirement and financial source, the financial plan has been prepared and is summarized in Table 1.1-6.

Table 1.1-6 shows that balance will be in the red in 1997, 1998 and 1999 because resident burden is set to half of SWM cost. Therefore, it is necessary to obtain subsidy from SGM until 1999 and profit tax of PLC shall be exempted in 1995 and 1996 to secure own fund to cover shortage in following years. And these shortages shall be covered by short term loan provided by domestic bank.

In year 2000, balance of PLC will change to black figures and PLC shall pay profit tax after 2000 according to the regulations.

Total debt will decrease from year 2000 and it will be US\$ 12.1 million in year 2005 in the case that tariff will remain the same level of year 2000 without incineration plant. Financial plan of the case with incineration plant and tariff increase in 2005 is shown in Figure 1.1-1 and is also feasible. Total debt in 2005 consists of the remainder of long term loan (US\$ 6.9 million) and short term loan (US\$ 5.2 million). Maximum requirement of short term loan will be US\$ 5.2 million in year 2005. Considering total amount of profit tax to be paid from 2000 to 2005 will be US\$ 9.1 million, PLC can manage priority project and running of SWM in territory of SGM.

Also, following point shall be examined considering establishment of better SWM system in Bulgaria.

- As mentioned above, profit tax of PLC shall be considered in relation to providing low cost service of solid waste management. At least this shall be used for better service of solid waste management including after care of final disposal site.
- Interest will be a heavy burden on PLC. Municipality shall consider some assistance for PLC to obtain better source of finance with low interest rate.
- Also subsidy for investment to promote upgrading of solid waste management shall be considered.
- Because of high inflation rate in Bulgaria, tariff of solid waste management shall be revised timely to secure necessary revenue for PLC.

Table 1.3-1 Financial Plan for PLC (in US\$ 1,000)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
A. PROFIT AND LOSS STATEMENT											
Revenue (1)											
Waste tax: Household	1056	1056	4106	4106	4106	8409	8409	8409	8409	8409	8738
Shops, etc.	5583	5583	5583	5583	5583	5583	5583	5583	5583	5583	5583
Collection Fee											
Shops, etc.	717	717	1036	1142	1249	1355	1366	1377	1388	1399	1410
Tipping Fee	38	38	129	133	137	141	142	144	145	147	148
Reusable Materials	0	0	20	21	109	264	428	591	755	919	1082
SGM Budget Allocation	325	325	325	325	325	0	0	0	0	0	0
Sub-total (1)	7719	7719	11199	11310	11508	15752	15928	16104	16280	16456	16961
Annual Expense (2)											
O & M Cost: Personnel	2380	2146	2169	2217	2257	2319	2354	2390	2441	2477	2512
Maintenance	1389	1249	1341	1432	1343	955	986	1018	1056	1087	1119
Others	1647	1467	2015	2100	1881	1919	1949	1977	2018	2045	2063
Depreciation	532	908	3858	4236	4713	5160	5315	5470	5642	5797	5949
Interest(long)	0	249	2394	2394	2388	2199	1989	1693	1397	1101	805
Interest(short)	0	0	0	94	255	553	531	354	84	0	295
Sub-total (2)	5947	6019	11778	12473	12838	13104	13125	12903	12638	12507	12743
Balance	1772	1699	-579	-1163	-1330	2648	2803	3201	3642	3949	4217
Tax	0	0	0	0	0	686	1458	1665	1894	2054	2193
Profit or Loss	1772	1699	-579	-1163	-1330	1963	1345	1537	1748	1896	2024
B. CASH FLOW											
Balance + Depreciation (3)											
Sub-total (3)	2303	2608	3279	3073	3384	7122	6661	7007	7390	7693	7974
Money Demand (4)											
Investment	4570	29552	4673	4286	3536	4451	1594	1193	2436	7027	7287
Loan Repayment											
Long Term	0	0	0	75	2225	2498	3653	3653	3653	3653	3578
Short Term	0	0	0	755	2043	4421	4248	2835	673	0	2358
Sub-total (3)+(4)	4570	29552	4673	5116	7805	11371	9495	7680	6761	10680	13224
Money Supply (5)											
SGM Budget	0	0	0	0	0	0	0	0	0	0	0
Long Term											
Foreign Loan	2725	11547	0	0	0	0	0	0	0	0	0
Local Loan	522	15056	0	0	0	0	0	0	0	0	0
User	0	0	0	0	0	0	0	0	0	0	0
Short Loan	0	0	755	2043	4421	4248	2835	673	0	2358	5250
Sub-total (5)	3247	26603	755	2043	4421	4248	2835	673	0	2358	5250
Surplus of Money	979	-341	-639	0	0	0	0	0	629	-629	0
Reserved Fund	979	639	0	0	0	0	0	0	629	0	0
Total Debt	3247	29850	30604	31818	31971	29300	24234	18419	14094	12800	12113

ANNEX 2
EIA REQUIREMENTS

Annex 2

Requirements for the Preparation of the Preliminary EIA Report

The preliminary EIA report shall contain:

1. An annotation of the project, facility or activity covering:
 - 1.1. the location - map (chart) of the area;
 - 1.2. the characteristics of the technology - technological chart;
 - 1.3. the environmental and economic characteristics.
2. A description of the environment subject to the impact.
3. A forecast for the impact on the environment.

Components	Characteristics	Assessment
Air	deterioration of quality prevailing winds. precipitation/humidity temperature/inversions	
Waters	surface waters - condition of the intake characteristics of waste waters degree of impact on the water body toxicity for water ecosystems underground water regime hydrological balance water users water consumption drainage systems floods silt regime	
Soils	deterioration of category, structure or productivity soil type chemical damage physical damage degree of erosion	
Plants and Animals Protected Areas	plant and animal species: extinction or decrease of populations	

Components	Characteristics	Assessment
Landscape	biological diversity; reduction or disruption of nutritive links ecosystems: extinction or damage of habitat protected areas; extinction of threatened and rare species	
Human Health and Safety	change (damage) of the landscape organization on the territory: areas for work, habitation and recreation noise non-ionizing radiation radioactivity wastes - collection and treatment affected population	
Socio-Economic Conditions	employment impact on the well-being and quality of life decline of the quality and quantity of the recreational opportunities	
Cultural Heritage	impact on historic, archaeological or architectural monuments impact on the current use of land and resources for traditional purposes	

Impacts which are not included in the characteristics of the components shall be described in a free form.

Requirements to the Preparation of the Final EIA Report

The final EIA report shall contain:

1. An annotation of the project, facility or activity containing information on:
 - 1.1. the location - map (chart) of the area;
 - 1.2. the characteristics of the technology - technological chart;
 - 1.3. the environmental and economic characteristics:
 - a) fixed assets - total, including the ones for environmental protection;
 - b) used resources: fuels and electricity; ores and non-ore mineral resources; raw materials; water resources; for production purposes (good for drinking, conditionally pure, repeatedly used); forest resources; recycled resources; land - according to the category;
 - c) area for depositing wastes;
 - d) output in physical terms and value;
 - e) profit rate.
2. Description of the environment which is subject to the impact:
 - 2.1. Condition of the atmospheric air:
 - a) characteristics of the climatic and meteorological factors influencing the condition of the air;
 - b) sources of pollution and quantities of pollutants in terms of type and composition;
 - c) pollution of the atmospheric layer above the ground surface and territorial scope of the areas with polluted air, taking into account the existing background.

The criteria for the condition of the atmospheric air are the upper limits for the harmful substances determined with the existing statutory regulations. Where harmful substances may interact in the atmosphere, their combined impact is taken into account;

2.2. Condition of surface and underground waters:

- a) quantitative and qualitative description of water resources on the territory and expected categorization of water bodies;
- b) hydrogeological and hydrological conditions and factors influencing the state and regime of surface and underground waters;
- c) major sources of pollution, quantity and location of the disposal of waste waters, composition and ways for their purification;
- d) major water users and water consumption by water categories;
- e) water supply location;

Components shall be studied and assessed in terms of the specific criteria as follows:

- a) territorial scope - depending on the radius of the impact: 5 km - small; 10 km - average; 50 km - substantial; 100 km - large; over 100 km - exceptionally large;
- b) degree of the impact - in percentage of the admissible limits; up to 50 % of the MAQ - insignificant; above 50 per cent of the MAQ - substantial; above the MAQ - dangerous;
- c) duration - short or long;
- d) frequency - low, high, regularly, continuously;
- e) recover opportunities - yes/no;
- f) cumulative effect.

The impact of the project, facility or activity shall be assessed generally in terms of all the components as follows:

- a) insignificant
- b) substantial;
- c) dangerous.

Where at least one component is assessed as "substantial" or "dangerous", the project, facility or activity shall be subject to a final environmental impact assessment report.

Where optional solutions exist, the choice of the option may be based on general rates as indicated in the formula:

$$K = \frac{\sum (V_i \frac{A_e}{A_i})}{1000}$$

where: V_i is the annual volume of the i -pollutant contained in waste substances;

A_e is the MAQ for the pollutant accepted as standard (the pollutant with the lowest degree of harmfulness);

A_i is the MAQ for the i -pollutant contained in waste substances.

The one with the lowest level shall be given preference.

4. A conclusion with recommendations on preparing a final report or making a final decision on the EIA.

- f) changes in the regime of water streams due to water consumption, river bed corrections, hydrotechnical equipment and others as well as their impact on the regime of underground waters and the overall condition of water ecosystems.

The criteria for the quantitative and qualitative condition of water resources are the hydroeconomic balance and the existing standards and rates;

- 2.3. Condition of soils and changes of the geological base and relief:
- identification of the changes of the geological base and relief as a result of economic activities;
 - identification of damaged lands (eroded, excessively humid, salinated, acidified, destroyed by economic activities and polluted with harmful substances and wastes);
 - deterioration of the land category depending on the degree of pollution or damage of soils; change of soil fertility.

The criteria for the condition of soils are the maximum admissible concentration of harmful substances and their evaluation-based categorization;

2.4. Condition of plants and animals:

- characteristics and assessment of the condition of vegetation, dominant and threatened plant species and their habitat;
- characteristics and assessment of the condition of animals, dominant and threatened animal species and their habitat;
- characteristics and assessment of the condition of protected areas.

The criteria for the condition and assessment are: the existing types of species; the numbers and viability of populations; the degree of threat for extinction of the species; characteristics of forests, presence of negative factors; degree of degradation and stability of ecosystems; specific regime on the protected area;

2.5. Sanitary and hygienic conditions in the habitat and its burdening with: noise, vibrations, non-ionizing radiation and radioactive pollution of the territory:

- characteristics of the territory;
- areas of acoustic discomfort and sources of noise;
- areas influenced by sources of electromagnetic fields, heat emission and radioactivity;
- characteristics of wastes, ways of their disposal, old waste deposits;
- characteristics of the social infrastructure;
- overall hygienic assessment of the territory.

The criteria for the condition of the habitat are the established maximum admissible levels of noise, the hygienic rates for electromagnetic and

radiation pollution of various territories and areas in the human settlements, waste rates.

3. A forecast on the expected impact.

The forecast is worked out by describing in detail the impact which the project, facility or activity will exert on the living and non-living nature and comparing it to the existing condition of the environment.
The forecast assessment shall cover:

- the changes in the condition of the various components of nature (air, waters, soils, flora and fauna) and their impact on the environmental balance;
- the changes of the anthropogenic load of the environment (settlements, population density, use of the territory, etc.);
- the changes of the sanitary and hygienic conditions and the environmental threat for the settlements or parts thereof and forecasting the health risks for the population with respect to the pollution with harmful substances, noise and other emissions, collection and disposal of wastes.

The forecast assessment shall contain quantitative and qualitative characteristics of the expected impact and refer to the methods used to identify them.

The results of the forecast shall be processed in accordance with the chart attached hereto and accompanied by an explanatory note.

- Alternative solutions and measures to reduce the harmful impact (described in the chart attached hereto).
- Value assessment of damages. (When alternative solutions are considered preference shall be given to the most acceptable one with respect to the impact on the environment). The source for recovery of the damages shall be indicated.
- Action plan for emergencies and outburst emissions of pollutants worked out by the investor or the person initiating the activity with the following contents:
 - assessment of the risk of emergencies and outburst emissions of pollutants;
 - measures and means to prevent, restrict and eliminate emergency emissions of pollutants.
- Monitoring plan indicating the means of monitoring and control of the harmful substances emitted from the project or facility; provisions for monitoring of the environment parameters, if necessary, at specific monitoring points with a view of restricting and preventing the harmful impact on the human health and environment.
- Conclusion with recommendations on the acceptance or rejection of the project, facility or activity and requirements for its fulfillment.

Chart for the Results of the Forecast on the Environmental Impact

Impact on Component Characteristics	Forecast on the Impact of the Project on the Environment		Measures for Reduction
	Direct Impact Construction	Indirect Impact Operation	
Air: quality of the air prevailing winds precipitation/humidity temperature/inversions			
Waters: surface waters intake - waste waters water ecosystems underground waters - regime hydrological balance water users drainage systems floods siltling regime			
Soils: deterioration of category structure/productivity soil type chemical damage physical damage			
Plants and Animals: plant species animal species biological diversity ecosystems protected territories			
Landscape: change (degradation)			
Human Health and Safety: organization of the territory noise non-ionizing radiation radioactivity wastes affected population			
Socio-Economic Conditions: employment well-being, quality of life recreation			
Cultural heritage: historic, archaeological and architectural monuments use of land and resources for traditional purposes			

The criteria set forth in Annex No. 2 are used to assess the expected impact. Impacts beyond the characteristics included in the chart are described in a free form.

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