to deteriorating agricultural water quality, and moreover, decrease in the yield of the fishing industry due to the deteriorating state of the coastal environment.

In the environmental aspect, the following were imposed as water quality worsens.

1) Swimming is prohibited in rivers due to terrible water pollution;
2) Fishes disappear and fishing becomes impossible;
3) The waterside becomes a dangerous place due to its unused state;
4) Water quality deteriorates and an offensive smell develops as a result of illegal waste dumping which is due to the abandonment of the area;
5) The river itself is an inconvenience and should be covered.

Among the social demerits within the environmental aspect, the damages in space utilization can be determined by multiplying the evaluated utilization benefits per person by the damage ratio of each item and then by water quality problems. However, the influence bestowed by the river's view as well as the role of nature or their complexity on human mentality and society is almost immensurable.

11.2.3 Evaluation of the Social Benefits of the River Environmental Improvement Project

(1) Social Benefits

The River Environment Improvement Project is generally considered to bring about the following benefits.

1) Life Benefits (Reduction of calamities and Environmental pollution)

2) Living Benefits (Landscape improvement, Air purification, Improvement in the amenities, Increase in recreational opportunities)

3) Socio-cultural Benefits (Activation of society, preservation of historical and cultural properties)

4) Natural Preservation Benefits (Protection of animals and plants, Preservation of streams)

5) Educational Benefits (Increase in educational opportunities concerning the environment and nature)

6) Economical Benefits (Curtailment of park improvement expenses, Increase of land value, Reduction of medical costs, Increase in the production of related industries, Increase in employment opportunities)

The river Environment Improvement Project proposed in this plan is also estimated to bring about the same social benefits mentioned above.

The results of the prevention of calamity should be given particular attention among the life benefits. The water of the rivers with improved water quality can be used as domestic water and fire prevention water in times of disaster, and the improved riversides are safe as emergency shelter areas. These benefits shall, therefore, compensate part of the cost allocated for the countermeasures in times of disaster.

The living benefits can be broadly interpreted as improvements in the living environment, and these kind of benefits are greatly expected from this kind of project than from other environmental projects. The increase in individual income shall result in demands for a higher standard of living and the benefits from this aspect shall compensate part of the cost allocated for the improvement of the city.

Remarkable attention is paid to social activation, one of the socio-cultural benefits. As the number of green areas multiply, water familiarity functions also increases and rivers become places for recreation and relaxation. Various events shall be held in the improved areas to improve communication between the new and old residents or young and old generation in order to strengthen their attachment to the area and feelings of solidarity. Although it is very difficult to quantitatively estimate the results, they can be noticed in the strengthening of the autonomy of the districts and the activation of society.

The curtailment of the park improvement expenses is considered as the largest economic benefit this project can offer. The necessity of the park improvement works in Seoul has been stated previously, but large amounts of money shall be needed to acquire land in the city. However, if the river bed areas are to be used, there shall be no land cost to consider and large benefits can still be gained in spite of inundation losses.

Educational benefits can be expected from the installation of the water quality improvement facilities and natural zones which shall help increase the citizens interest in environmental preservation. On the contrary, however, the citizens might lose their interest in the discharge of pollutant substances and the administrators' zeal to promote soft countermeasures might be dampened if any water quality problem can be solved technologically (i.e. facilities, machines). It is, therefore, very important to guide and educate the residents properly.

(2) Benefits from the increase in the number and area of parks

Table 11.2-1 shows the evaluation of the benefits gained from the increase in the number and area of the parks estimated by using the park land acquisition cost as proxy value/variable. The benefits to be gained if river beds are to be used were estimated as 90% (Area to be improved x vicinal land cost), because inundation losses can be anticipated.

Table 11.2-1 Park Improvement Cost Reduction Effect

River	Model Site	Area (ha)	Land price around the river (1000 won/m^2)	Discount rate	Benefit (million won)
Anyang	M1	12.0	938	0.9	101,304
	M2	12.0	739	0.9	79,812
	M3	5.0	1,044	0.9	46,980
Yangjae	M1	11.0	1,464	0.9	144,936
	M2	7.0	1,582	0.9	99,666
Ui	M1	4.0	781	0.9	28,116
Chungroung	M1	1.0	1,283	0.9	11,547
Total					512,361

* Area: Area of major bed
* Benefit = (Land price around river) x (Area) x 0.9

(3) Benefits of an improved living environment

The benefits to be gained from the improvement of the living environment were estimated by using land cost as proxy value/variables since the cost of land increases as the living environment improves.

The construction of the model site is based from 5 factors namely, distance of the land from the environment and the city, traffic conditions, population density and land utilization. Through the use of the model and quantification method I, the degree of influence of each factor on official land prices were calculated. The results showed that the environmental factor carries an effect of 31% for residential areas and 28% for residential and industrial purposes. Therefore, if the water quality of the river is improved during the 1st phase of the project, the cost of the land situated 100m away from the river shall be increased at a rate of 5% and shall bring about the benefits shown in Table 11.2-2.

Table 11.2-2 Benefits of an Improved Living Environment

River	Effective sphere	Distance (km)	Rise in the land Price (thous. won/m^2)	Benefits (million won)
Anyang	St.6-St.5	3	37	22,200
Yangjae	St.2-St.1	3.5	73	51,100
Ui	around Model Site	1	39	7,800
Chungroung	St.3-St.2	3	1,283	38,400
Total				119,500

11.2.4 Feasibility of the Project

As mentioned above, the benefits to be gained from the increase in the number and area of parks amount to 464.3 billion won, an amount which is approximately 17 times more than the Phase I improvement project cost and approximately 5 times more than the water quality improvement, flow improvement and operation and maintenance cost.

The benefits from the improvement of the living environment amount to 119,7 billion won, an amount which is twice the Phase I project cost. Furthermore, the addition of other unevaluated benefits would indicate that the effects of the Phase I project shall counterbalance the costs.

11.3 Environmental Influence of the Project and Its Counter-measures

There is a possibility that the construction works, the existence and the use of the facilities, etc., shall cause environmental problems in the project area. It is, therefore, important to study and formulate in advance measures that shall counter-act

the their negative effects on the ecological system and the residents.

11.3.1 Environmental Factors Caused by Construction Works

- Noise, vibration, dust
- Muddy water and flow reduction due to low channel improvement works and dredging
- Leaking of waste water due to replacement of the intercepting sewer
- Traffic snarls, accidents, noise, vibration and exhaust gas caused by construction vehicles

Although these factors shall only prevail during the construction period, it is necessary to formulate countermeasures such as the use of construction methods and machineries that shall minimize noise, vibration and water quality pollution; setting up of a suitable construction period and time schedule; and installation of required access roads.

Furthermore, there is no need to protect or preserve animals and plants because the eco-system in the river and riverside has deteriorated due to flow shortage and poor water quality.

11.3.2 Environmental Impacts Caused by the Existence of the Facilities and their Countermeasures

- Bad smell originating from the sediment basin
- Muddy waste, accumulated wastes and weeds in the upstream area of the weir gate
- Reduction of river flow capacity due to the existence of facilities in the river channel
- Worsening of the view due to the existence of facilities in the river channel

As long as the facilities exist, these impacts shall persist. Therefore, things must be given full consideration in the design-

ing stage and the required facility operation and maintenance works should be conducted efficiently.

11.3.3 Environmental Impacts by facility use and its countermeasures

- Bad smell and waste water leakage caused by the removal and shifting of mud waste accumulated at the water purifying facility;
- Wastes, noise and increase in traffic volume due to sports and recreation facilities.

Since the occurrence of these problems shall rely greatly on the users and the time these facilities shall be used, it is necessary to predict in advance the behavior patterns of the users and to formulate appropriate countermeasures.

Chapter 12

Chapter 12 Considerations

12.1 Future Monitoring and Supplementary Survey

It is necessary to fully understand the variations in every station, every discharge, water quality and topographic conditions of the rivers in this study and their causal factors in order to decide a suitable scale and location for the water purifying facility and in order to maintain the facility for a long period of time. With reasonable operation and maintenance cost, these factors are considered very important for the safe and effective use of the river space.

River discharge and water quality observation shall be continued until the design is implemented to gain a more accurate understanding of the variations in every river and their causal factors. There is also a need to repetitiously monitor the profile and cross section survey of the rivers' changing topographical conditions to understand the run-off patterns of rainfall and sandy soils, both of which directly influence river discharge and water quality.

It is also very important to conduct a study on the maintenance of the sewerage facilities.

The method and the result of these surveys are described in the Supporting Report.

The future projection of the apperance of new plants and animals may be investigated as one of the studies conducted in future.

12.2 Methods of Alteration

The basic concept and project plan proposed and formulated here are very restricted technologically and financially. However, the plan shall be modified as the preconditions undergo future alterations.

The results of the systematic and continuous discharge and water quality survey conducted by this study were obtained. However, it is difficult to state that with these data we have come to grasp the normal conditions of the rivers, since the survey period was only limited to 17 months and the amount of rainfall was twice the normal average per year. Furthermore, the observation results were also affected by the rapid development of the Kangam area, the area where Anyang Chong and Yangjae Chong run through, because various construction works were being conducted at the riverside and its circumference during the observation period.

The progress in the improvement and reparation of sewerage facilities is considered to have the greatest influence on the technological aspect. Although the problems involved in the sewerage facilities have been pointed out in this plan, a systematic research on the actual conditions has not been conducted yet. The Seoul Metropolitan Government undergoes the same situation too. Although it acknowledges that the existing sewerage facilities are in need of repair,they have not formulated anything definite yet.

Furthermore, although the Anyang-shi Government and other organizations have formulated a sewerage improvement plan which is already being implemented, there is no guarantee that this plan shall be accomplished by the target year 2001. We, therefore, conclude that there are considerably many uncertain factors to be considered in the apparent run-off ratio.

Facility design and project cost estimation are based on the

estimated apparent run-off ratio, which means that the former shall be changed as the latter changes.

Countermeasures must be modified according to the results of the monitoring survey of the river's discharge and water quality as well as the progress of the improvement and reparation of the sewerage facilities.

Similar to other projects, the implementation of this project shall rely greatly on its financial resources. Since the river environment improvement project shall benefit the public, it is only natural to assume that this project shall be financed generally. However, the enormity of the expenses makes the securement of funds from other related organizations difficult, and it is possible that the project shall take longer than scheduled. It is, therefore, necessary to look for other financial sources.

The way the river environment improvement project in the present urban area did. This project, just like the Mukodon Development project, was accomplished through the help of special funds by including flood related projects.

The majority of the investments cover the water quality improvement facilities, and these facilities shall be installed because the run-off ratio of pollutant load has not fully decreased. The installation expenses shall be considered as special sewerage treatment expenses until the sewerage facilities are rehabilitated completely.

In any case, the establishment of a financial committee is expected because the financial source is considered to have been confirmed.

12.3 The Organization of the River Environment Improvement Project

To promote environment related projects, it is important for the administrators to fully understand the nature of the environmental problems and to establish an organization which shall deal with these problems.
The 2 kinds of organization indicated below are proposed for the promotion of this project.

(1) Water Quality Improvement Committee

If a river basin covers more than two cities, the members of these cities shall organize a water quality improvement committee. The committee shall then formulate countermeasures for the entire river basin and shall promote coordination among cities.

The river improvement project should basically start upstream, otherwise nothing can be accomplished efficiently. It is, therefore, very important to gain the cooperation of the cities situated upstream.

(2) River Utilization Plan Coordinating Committee

River projects involve 3 fields, namely water utilization, flood control and water familiarity functions (drainage, river space utilization, environmental preservation). It is, therefore, important to coordinate every river area possessory plan in order to create a river environment fitting to the city.

The bureaus in Seoul Metropolitan which are involved in the above mentioned fields are the Sewerage Bureau (River Maintenance and Sewerage Treatment Division), Park and Environment Bureau (Parks, Environmental Preservation, Green Belt and Landscape Division), and Transportation Bureau (Parking Area Planning Division). It is, therefore, most advisable to form the River Utilization Plan Coordinating Committee from these bureaus.