Research on regeneration and utilization of rivers in the Tokyo Metropolis (PART1)
A study on conditions for revivals of covered rivers in the Tokyo 23 wards area

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Abstract

With the rapid urbanization of Tokyo, many rivers were covered with concrete. Recently, there has been renewed interest in the importance of rivers in cities for the improvement of heat islands as well as to provide recreational spaces close to rivers. It is important to arrange green spaces along with access to rivers to improve the urban environment. This study was performed to investigate the possibility of revival of covered rivers in the Tokyo 23 wards area. An evaluation index was made based on exploration of the present condition of covered rivers: *i.e.*, conditions of the open space, amount of water, and reservoir setting. Of the covered rivers examined, 0.7% qualified for revival with respect to all of these physical conditions. Research into the volume of sump water is expected to provide new methods for reviving covered rivers.

Keywords: revival of rivers, covered rivers, recreational spaces close to rivers, environment of cities, heat island

1. Introduction

1.1 Purpose of this study

There is now a great deal of renewed interest in the importance of rivers in cities for the improvement of heat islands as well as the provision of recreational spaces. In fact, a road covering Seikei River was removed, reviving this river in Korea. This will contribute to a drop in the temperature of Seoul. In Tokyo, many small and medium rivers were covered with concrete due to the sudden population increase in the Tokyo 23 wards area. In addition, in the case of Nihonbashi River, an overpass covers the river, spoiling the view and blocking access to the river. Revival of these rivers will be effective for improving the city environment and to create recreational spaces close to the rivers. This study was performed to investigate the possibility of revival of covered rivers in the Tokyo 23 wards area.

1.2 Definition of covered rivers

Covered Rivers are waterways that have structures produced using the cast-in-place concrete or box culvert construction method that cover part or all of the width of the river. Fig. 1 shows a section of a covered river. Legal covered rivers and public covered ditches are also included.

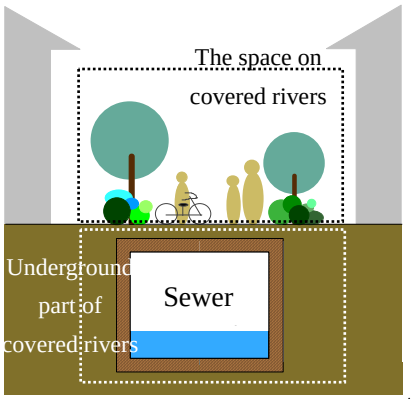

Fig. 1. Covered River

2. The present condition of covered rivers

2.1 The space on covered rivers

A field survey of covered river spaces was performed. These were mainly divided into 67% roads and housing sites, 27% greenways and parks (unreproducing waterways), and 6% greenways and parks (reproducing waterways). The distribution is shown in Fig. 2.

2.2 Underground part of covered river

The survey of the sewer ledger was performed with regard to the underground part of covered river. These were divided as follows: 79.4% combined sewer system, 20.2% waterways (underdrain), and 0.4% separate sewer

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system. The distribution is shown in Fig. 3.

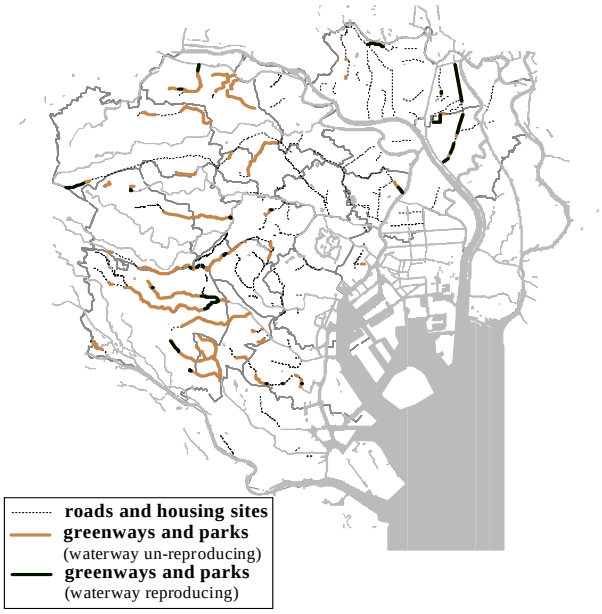

Fig. 2. Area of covered rivers

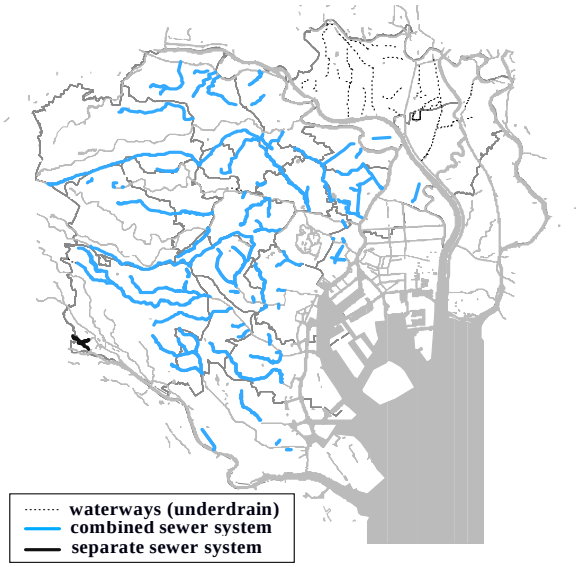

Fig. 3. Underground part of covered rivers

2.3 Survey of administration attitude

2.3.1 Attitude regarding revival of rivers

A survey of the attitude of the administration of the Tokyo 23 wards area regarding the revival of rivers was performed. Replies were obtained from 20 of the 23 wards. Items investigated were as follows:

1. Conditions required for revival of covered rivers
2. Intention to revive covered rivers when these conditions are met
3. Existence of measures for revival of rivers

The results are shown in Figs. 4, 5, and 6. As shown in Fig. 4, the conditions required by the administration for revival of covered rivers were approval of residents, reservation of amount of water, and reservation of budget. As shown in Fig. 5, 61% of the ward administrations expressed a willingness to revive covered rivers when conditions are met. In addition, Fig. 6 shows that 62% of the ward administrations have measures in place for the revival of rivers. Therefore, there is a generally positive attitude within the administration toward the revival of rivers.

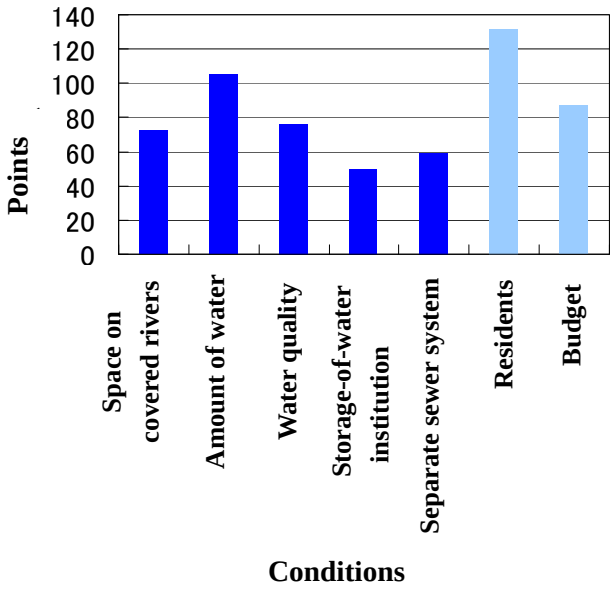

Fig. 4. Conditions for revival of covered rivers

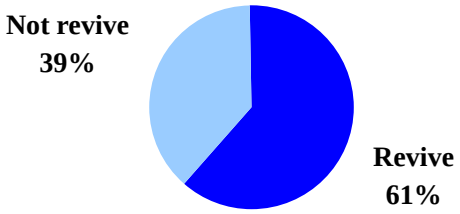

Fig. 5. Intention for revival of covered rivers

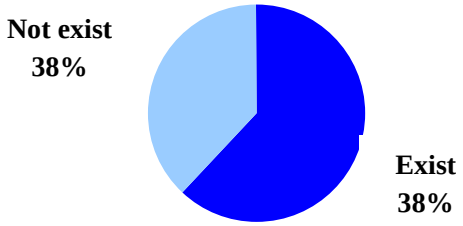

Fig. 6. Existence of measures for revival of rivers

2.3.2 Attitude on separate sewer system

A survey of the attitude of the Sewerage and Sewage Purification Department of Tokyo concerning changing the combined sewer system into a separate sewer system was performed. However, they said that they would not change the sewer system because it uses existing stocks efficiently and because residents would have to bear the financial burden of such reconstruction.

3. Suggestion for revival of covered rivers

3.1 Conditions necessary for revival

The conditions necessary for revival were considered based on the present condition of covered rivers. Social conditions include approval of residents, reservation of budget, necessity of the space for recreation, and revision of river law. Physical conditions include extra space on covered rivers, reservation of amount of water, and improvement of water quality. This study discusses physical conditions because a lack of such conditions will make revival of covered rivers impossible.

3.2 Conditions of space on covered rivers

The average width of waterways of existing water parks is 2.64 m and the average width of walking trails of existing water parks is 2.14 m. Based on these figures, the necessary space required to revive waterways on covered rivers was set at 4.78 m (Fig. 7). Among the 223 km of covered rivers in the area, 25% meet these conditions (Fig. 8).

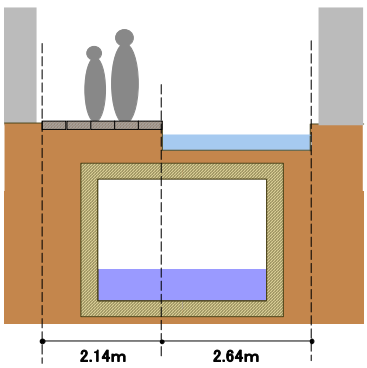

Fig. 7. Waterway revival

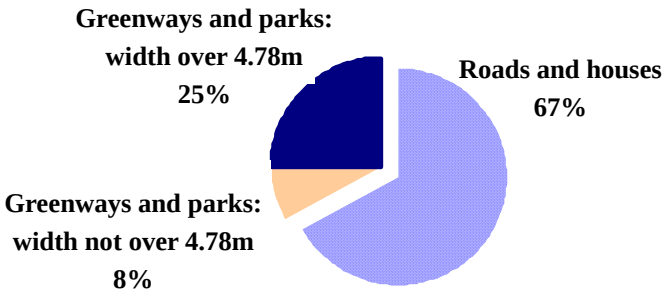

Fig. 8. Width of greenways and parks

3.3 Conditions of water quality

In covered rivers, combined sewer systems pass dishwater, while separate system sewers pass rainwater, and waterways (underdrains) pass stream water. Separate system sewers and waterways can utilize existing stock, but combined sewer systems require approval. Headwaters utilize rainwater, sewage treatment water, and sump water. Fig. 9 shows the distribution of headwaters and the regenerable space.

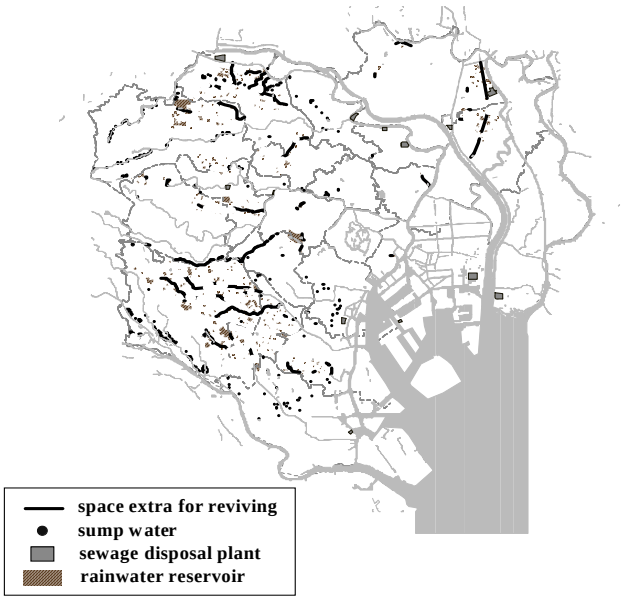

Fig. 9. Headwaters and the regenerable space

3.4 Amount of water

3.4.1 Calculation of the necessary amount of water

Calculations of the necessary amount of water per month are based on the average width, water depth, and current speed. The average values in this area are as follows: width, 2.64 m; water depth, 0.27 m; current speed, 0.30m/s.

3.4.2 Calculation of water catchment capacity

Calculations of rainwater catchment capacity are based on precipitation and divides are determined from contour maps. A run-off coefficient of 0.3 is used to ensure safety. In addition, sewage disposal plants that are located higher above sea level than the upstream regions of covered rivers are computed for available sewage treatment water (advanced treatment water volume) catchment capacity. In addition, for safety reasons sump water is not included in the amount of water.

3.4.3 Investigation of possibility of rainwater reservoir setting

Calculation of water catchment capacity is based on areas of schools and parks that exist in the divide to determine whether rainwater will supply sufficient reserve to meet the requirements.

3.4.4 Investigation of amount of water

In the area investigated, which includes 223 km of waterway, 1.3% of covered rivers meet the needs by rainwater and sewage treatment water, of which 0.7% can reserve the necessary amount of water for reservoirs for schools and parks. This is shown in Fig. 10.

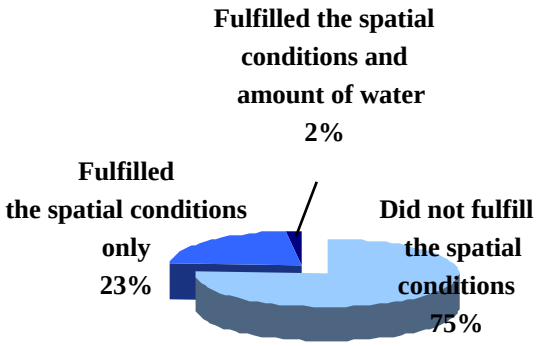

Fig. 10. Covered rivers fulfilling water amount criterion

4. Possibility of revival of covered rivers

4.1 Evaluation index

Covered rivers are classified according to conditions of revival in Fig. 11.

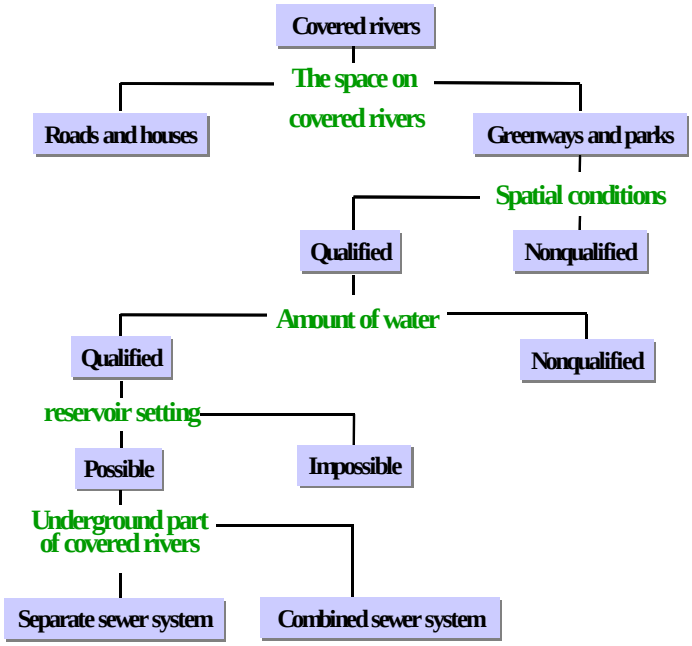

Fig. 11. Classification of covered rivers

4.2 Evaluation of possibility of revival

Evaluation of the possibility of revival of covered rivers is based on Fig. 11. Of the covered rivers, 33.2% are greenways and parks on covered rivers, and 25.5% meet spatial conditions because these have over 4.78 m in width in addition these are greenways and parks. Of the total number of covered rivers, 1.3% meet both these spatial criteria and provide the necessary amount of water. Of these rivers, 0.7% can be set as reservoirs at schools and parks. These 0.7% of the rivers are waterways (underdrains) that pass stream water, so existing stocks are available for use. None of the covered rivers that met the conditions of space extra, amount of water, and reservoir setting have combined sewer systems.

Consequently, 0.7% of covered rivers met all of the physical criteria required for revival. Fig. 12 shows the distribution of covered rivers with a high possibility of revival.

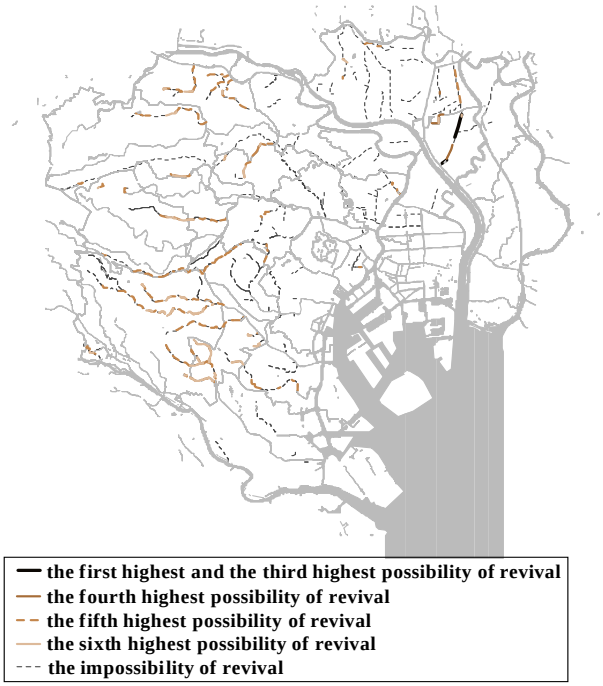

Fig. 12. Distribution of possibility of revival

5.Conclusions and future tasks

5.1 Conclusions

There are necessary physical conditions for revival of covered rivers. One is having sufficient space as greenway or park or having extra space for water storage facilities. A good supply of water is also required. Based on these conditions, 0.7% of the covered rivers in the area examined can be revived, and these are all waterways (underdrains). Physical impediments to revival of covered rivers include roads or housing built over the covered rivers and poor water supply. Reduced width of greenways and parks may be another physical impediment. Inability to obtain the consent of local residents may also be a social impediment to the revival of covered rivers.

5.2 Future tasks

Obtaining sufficient water supply is important for revival of covered rivers. Groundwater levels are rising. Therefore, sump water is expected to maintain the water supply. Research into the volume of sump water is expected to provide new methods for reviving covered rivers. Further studies are required to determine how best to revive covered rivers that have roads built over them, such as Seikei River in Korea.

References

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