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## The Public Sewerage Works of Sapporo City : Factors Behind the High Treated-Sewage Ratio and the Financial Problem

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### Abstract

The treated-sewage ratio of Sapporo City reached a high level in spite of the fact that the secondary industry of Sapporo is weak and its population is rapidly increasing. This study focuses on these particular characteristics of Sapporo City. Principally, the cynosures of attention were the treated-sewage ratio and the revenue source problem. More specifically this study aimed to : 1) uncover the factors behind the high treated-sewage ratio and 2) clarify the sources of revenue and the financial problems consequent to public sewerage works. Based on the results of the above examination the following points have been elucidated : 1) The bid to hold the 10th and 11th Winter Olympic Games encouraged the setting up of a construction plan as part of an urban environment reconstruction program. Thus, investments in sewerage treatment plant construction were intensively made and the rate of government subsidies greatly increased. 2) The source of construction expenditures was government subsidies and bond issues, but from 1965 to 1972 substantial amounts of city funds were used. As regards financial problems, the burden of city expenditures became heavier because of the rapid increase in loan payments due to greater outstanding bond issues. Moreover, in spite of the fact that the sewerage works of Sapporo City are basically completed an increase in construction expenses has recurred starting in 1986 which has been brought about by the furtherance of flood countermeasures.

**Key Words** : Public Sewerage Works, Treated-Sewage Ratio, Sewerage Finance, Revenue Source Problems,

### 1. INTRODUCTION

Sewerage is indispensable in ensuring a safe, healthy and pleasant environment and in planning for the preservation of water quality in public water areas. However, it is a fact that sewerage infrastructure in Japan lags behind that of Western countries. Accordingly, emphasis was placed on sewerage infrastructure and in 1986 the national treated-sewage ratio reached 38 percent. It is important to note that differences in the treated-sewage ratio exist between urban and rural areas, and even among urban areas themselves. While the treated-sewage ratio in urban areas with more than one million inhabitants has reached 80 percent, the treated-sewage ratio in smaller cities and rural areas is extremely small. In the case of urban areas, differences in the treated-sewage ratio exist because of differences in development processes and city planning.

Public sewerage works involve a vast amount of expenditures. Consequently, the source of revenue becomes an important problem. Likewise, public sewerage works require a long construction period and this calls for long-term city planning and urban policy.

Among those cities which grew rapidly after the war, Sapporo is one of the cities which exhibited a remarkable increase in population. Moreover, with regard to public sewerage works, Sapporo shows a high treated-sewage ratio, a ratio which has reached 92 percent. This study focuses on these particular characteristics of Sapporo City. Principally, the *cynosures of attention* will be the treated-sewage ratio and the revenue source problem. More specifically this research aims to :

- 1) determine the causes of the high treated-sewage ratio
- 2) elucidate the sources of revenue, and
- 3) clarify the financial problems attendant to sewerage works.

This study is organized as follows: Chapter 2 examines the distinctive features and trends of public sewerage works in Sapporo City, and the causes of the rapid treated-sewage ratio increase; Chapter 3 examines the trend of public sewerage finance and clarifies the financial problems resulting from public sewerage works, and Chapter 4 presents conclusions derived from the study and future issues for study.

## **2. The Development of Public Sewerage Works and the Causes of the Rapid Increase in Treated-Sewage Ratio**

### **1) Distinctive Features of Sapporo City**

The comparison of the outline of development of public works between Sapporo City and the other urban cities reveals that among the government designated urban cities, the commencement of public sewerage construction in Sapporo City and Kitakyushu was late. The opening of sewage treatment plants in Sapporo City was around 1-2 years ahead of Kita Kyushu, Fukuoka City, and Yokohama City but from a national viewpoint the start of sewage treatment plant operation in Sapporo City was relatively late (Table 1). The rate of population increase for Sapporo City from 1965 to 1986 was remarkable, and like Hiroshima City this rate increased two fold. It has to be noted that Sapporo City along with Hiroshima City and Fukuoka City have shown big increases in growth. In spite of this rapid increase in population, the treated-sewage ratio of Sapporo City increased from 1.6 percent to a high of 92.7 percent, compared to the 0.7 and 70.4 figures for the increase in the treated-sewage ratio of Fukuoka City. Moreover, magnitude of the increase in treated-sewage ratio of Sapporo City is clearly evident when compared with that of Hiroshima City, a city which exhibited an almost equal population increase as Sapporo City but a comparatively lower treated-sewage ratio increase of 42.6 percent. A detailed look at the increases in treated-sewage ratios shows that the increases in treated-sewage ratios of urban areas other than Osaka City from 1967-1969 was 19 percent. However, the treated-sewage ratio of Sapporo City showed an increase from 19.2 percent in 1970 to 51.6 percent in 1971. This is an obviously disproportionate increase in treated-sewage ratio of a little more than 30 percent.

Table 1. Trends in Public Sewerage Construction and Treated-Sewage Ratio in Urban Areas

(%)

	Sapporo	Tokyo	Yokohama	Nagoya	Kyoto	Osaka	Kobe	Hiroshima	Kitakyushu	Fukuoka	Kawasaki
Start of sewerage construction :A	1957.4	1911.6	1950.10	1908.2	1930.8	1912.1	1951.4	1951.4	1957.9	1930.4	1931.11
Start of treatment :B	1961.4	1952.10	1962.4	1912.11	1934.3	1940.4	1958.11	1961.4	1963.7	1962.10	1934.3
Rate of population increase :C	98.2	-6.4	71.4	9.1	-8	-16.5	17.1	98.0	0.9	56.4	28.6
Treated-sewage ratio:D											
1965	1.6	32.4	5.8	58.4	34.8	37.5	18.6	14.0	7.1	0.7	14.4
1966	2.0	35.6	6.3	62.6	41.2	44.4	21.9	14.8	9.9	10.8	18.2
1967	7.6	38.3	7.2	67.9	42.6	51.4	23.8	14.5	6.6	13.6	21.4
1968	10.4	40.9	10.1	69.9	44.8	63.4	22.9	14.6	10.7	12.3	25.9
1969	16.9	44.8	16.2	68.6	46.3	70.4	29.2	14.7	15.8	15.6	25.0
1970	19.2	45.1	16.5	67.6	41.9	56.4	36.0	14.8	16.8	18.6	28.1
1971	51.6	48.2	17.9	70.3	43.4	72.3	42.9	14.8	21.5	23.1	29.0
1972	57.2	50.9	19.4	69.9	44.8	82.7	51.3	23.7	33.7	29.5	29.2
1973	61.8	54.3	21.5	67.3	47.7	90.1	57.0	21.8	39.7	31.2	26.6
1974	62.9	57.5	24.1	68.3	47.9	93.7	63.3	22.7	41.9	32.8	26.9
1975	64.5	59.2	26.6	69.7	47.7	94.8	72.9	22.4	44.9	33.6	26.8
1976	64.6	60.9	28.7	71.0	48.1	94.9	77.1	22.3	49.0	34.5	26.6
1977	68.1	63.5	31.0	73.0	49.9	96.1	79.6	25.8	52.4	36.1	31.5
1978	76.1	65.6	34.5	75.1	52.0	97.3	81.5	27.5	56.7	37.3	33.8
1979	80.2	68.4	38.5	77.5	55.6	97.8	84.7	28.8	64.4	40.1	34.5
1980	85.9	70.4	42.9	79.8	58.8	98.0	86.7	32.7	68.5	38.2	35.6
1981	88.4	73.1	46.7	81.4	63.3	98.1	87.8	36.0	70.6	39.7	36.9
1982	89.5	74.8	50.6	81.6	67.0	98.6	88.7	38.1	73.1	50.8	44.7
1983	90.0	76.3	54.7	82.1	66.8	98.9	90.1	39.8	75.7	54.9	46.5
1984	91.0	76.1	60.2	82.6	68.6	99.3	90.7	33.4	78.8	59.5	47.7
1985	91.8	80.5	65.5	83.5	71.7	99.4	92.1	34.8	80.7	65.6	51.0
1986	92.7	82.6	70.5	84.7	79.2	99.6	92.5	42.6	83.5	70.4	54.4

Public Sewerage Finance

Source :1) Data A and B are from the Local Public Enterprise Management Research Institute ed., "Local Public Enterprise Yearbook", Local Financial Affairs Association, 1986.

2) Data C and D are from the Japanese Sewerage Association, "Sewerage Statistics", 1965-1986.

Notes :1) Start of sewerage construction refers to the year when permission for the construction plan was obtained the government.

2) Start of treatment refers to the year when sewage treatment plants started operation.

3) Population increase rate is the ratio of the 1965 and 1986 administration population.

Thus it can be said that in spite of the late development of public sewerage works and the rapid population increase in Sapporo City, Sapporo's treated-sewage ratio rapidly increased. This rapid increase explains nearly complete public sewerage works in Sapporo City.

## 2) Trend of the Public Sewerage Works Plan

Public sewerage works in Sapporo City commenced full-scale in 1957 but the actual planning of public sewerage works was first carried out in 1965 when the six-year public sewerage construction plan was envisioned (Table 2). Moreover, a continuous program of five-year plans starting from the first five-year plan of 1971 up to the fifth five-year public sewerage construction plan, was set up. The second five-year plan was enforced a year earlier than planned, and the consequent five-year plans were also carried out in the same manner. The third five-year development plan was, thus, carried out in 1980, and the fourth five-year plan was enforced in 1984.

The primary objective of public sewerage construction plans is increasing the treated-sewage ratio. From 1963-1967, the treated-sewage ratio was computed as the ratio of drainage area to the urban district area. Thus, area was used as base of the computation. However, after 1967 population was used as base of the computation. Up until 1975, the treated-sewage ratio was computed as the ratio of the drainage population to the urban district population. Since then, the treated-sewage ratio has been computed as the ratio of treatment population to total population. It should be noted that sewage treatment refers to the process by which sewage is carried by drain pipes, passed through pumping stations and then led up to sewage treatment plants. This invariably is an integrated process and the treatment population is determined thereby. Directly speaking, the

**Table 2.** Sewerage Construction Plans in Sapporo City

	6 Year	1st 5Year	2nd 5Year	3rd 5Year	4th 5Year	5th 5Year (plan)
Planned Priod	1965-1970	1971-1975	1976-1980	1980-1984	1984-1988	1988-1992
Enforcement Period	1965-1970	1971-1975	1976-1979	1980-1983	1984-1987	1988-1992
Total Population (thousand)	1001	1241	1367	1493	1595	1716
Treated Population (thousand)	194	800	1099	1344	1490	1658
Treated-Sewage Ratio (%)	19.2	64.5	80.4	90.0	93.4	96.6
Amount of Planned Investment (100 million ¥)	120	480	1700	1960	1310	1310
Actual Amount Invested (100 million ¥)	167	640	1613	1711	1496	
Ratio of Investment to Sewage Treatment Plant (%)	43.9	20.9	18.9	24.2	16.4	

Source :1) Sapporo City, "Explanation of Accounting Settlement of Accounts", 1965-1986.

2) Sapporo Sewerage Bureau, "Sewerage in Sapporo City", 1988.

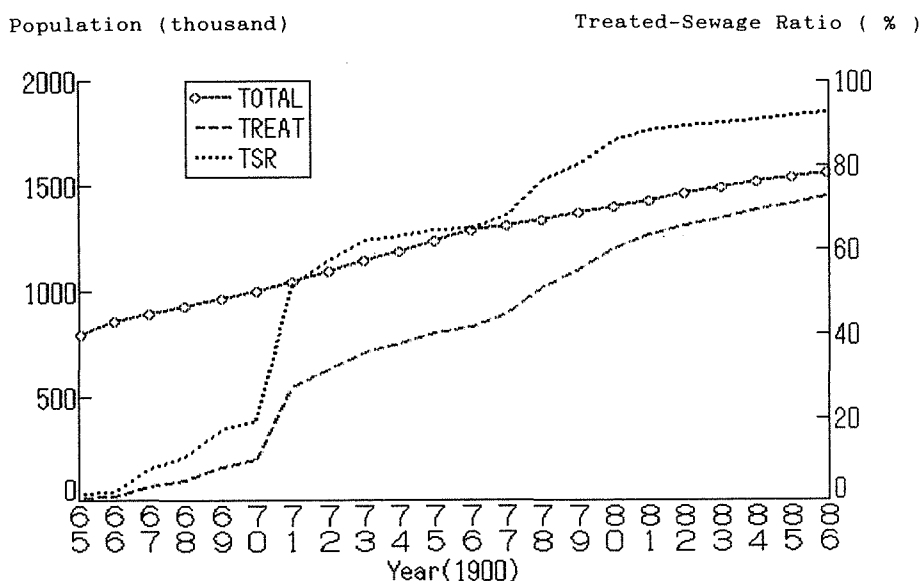
Notes :1) 6 Year refers to the 6-year sewerage construction plan.

2) 1st 5 Year refers to the first 5-year sewerage construction plan.

3) The figures are for the last year of the enforcement period.

construction of drain pipes does not in itself constitute sewage treatment, but rather the construction of treatment plants and the commencement of their operations. Accordingly, the construction of treatment plants is the key factor leading to an increase in the treated-sewage ratio.

The first treatment plant was constructed in 1961 in Makomanai by the Hokkaido prefectural government. Within the six-year planning period, the Nopporogawa, Souseigawa, Fushikogawa, Toyohiragawa, and Jozankei treatment plants were constructed and started operation. During this six-year planning period, the amount of investment for treatment plants reached 43.9 percent of construction expenditures, an amount two times more than the share of investment embodied in the subsequent five-year plans. This indicates that investment was carried out intensively during the six-year planning period. Within the first five-year planning period, the Shinkawa and Atsubetsu treatment plants were constructed and in 1971 sewage treatment the majority of urban areas was made possible. The Barato, Teine, and Takuhoku sewage treatment plants were then consecutively constructed. Moreover, the yearly increase in treatment capacity is directly related to the increase in treated-sewage ratio. Figure 1 shows that from a mere 1.6 percent in 1965, the treated-sewage ratio rapidly increased to 92.7 percent in 1986, an achievement of nearly complete sewerage in around twenty years. More specifically, from 1970-1971 many sewerage treatment plants were constructed and this led to the rapid increase in the treated-sewage ratio. The rapid increase in the treated-sewage ratio can not only be



**Figure 1.** Trends in the Treated-Sewage Ratio in Sapporo City.

Source : Japanese Sewerage Association. "Sewerage Statistics", 1965-1986.

Notes 1) TOTAL refers to the Population in Sapporo City.

2) TREAT refers to the Treatment Population in Sapporo City.

3) TSR refers to the Treated Sewage Ratio in Sapporo City.

traced to the increase in sewage treatment plants but also to the increase in the construction of drain pipes. Likewise, Figure 1 also shows that from 1977-1981 the treated-sewage ratio increased by more than 20 percent. Thus attention will be focused on two periods, 1970-1971 and 1977-1981, in determining the causes of the rapid increase in the treated-sewage ratio of Sapporo City.

### 3) Causes of the Rapid Increase in Treated-Sewage Ratio

Let us first consider the period of the biggest treated-sewage ratio increase, that is 1970-1971. It can be said that a sharp increase in treated-sewage ratio was recorded in 1971. As was previously mentioned, the construction of sewage treatment plants was carried out before the year as part of the six-year plan and as such it is surmised that in preparation for the staging of the 11th Winter Olympic Games, Olympic-related investments were made. The staging of the Winter Olympic Games in Sapporo City was decided in 1966 and preparations were immediately made. Efforts were expended on the construction of sports facilities, roads, transportation, housing, water works and sewerage, lodgings, electricity, and communication-related facilities. As Table 3 shows, expenditures for the construction of transportation-related facilities were relatively large and expenditures for sewerage facilities amounted to 2.5 billion yen. The amount invested for sewerage reached the amount allocated for a year as set forth by the six-year plan. The majority was earmarked for the construction of drain pipes attendant to the construction of roads and streets. The amount allocated for the construction of sewage treatment plants was 173 million yen, the amount set for the Makomanai sewage treatment plant.

**Table 3.** Facilities Construction Expenditures Related to the 11th Olympic Winter Games (million ¥)

	Total Amounts	City Burden	Details of City Revenue Source			
			General Account	Bond	Subsidy	Others
Transportation	49170	45491	1458	42988	802	243
Road	84997	22089	4054	7451	10584	—
Land Readjustment	11476	11476	2808	3751	3585	1332
City Hall	8910	4080	50	1544	—	2486
Sewerage	3094	2463	739	39	985	—
Environmental Hygiene	3545	450	450	—	—	—
River Maintenance	481	122	31	35	56	—
Total Facilities Construction Expenditures	199400	87172	9970	56508	16012	4682
Total Expenditures related to the Olympic Games	221202	90496	12141	57153	16027	5175

Source : General Affairs Department Olympic Games Administration Office in Sapporo "A Report on the 11th Olympic winter Games", Dec.1972,pp.239-243.

Note : Subsidy refers to the subsidies by the national government and Hokkaido Prefecture.

Investment for sewerage due to the Winter Olympics was around 11.4 percent of the total construction expenditures for the period from 1967-1971. As presented in Table 4, the share of city expenditures as a sources of construction funds was the same as that of government subsidies from 1965 to 1970. From 1970 until 1972, the share of city expenditures was more than 10 percent. This was the share of city expenditures before the Winter Olympics. However, from 1965-1971 the share of city expenditures for construction averaged about 24.1 percent. Thus it can be said that the effect of the Winter Olympics on sewerage construction came in the form of city expenditures which were allocated as Olympic-related subsidies.

The effect of the Winter Olympics on sewerage works can also be inferred from occurrences prior to the 11th Winter Olympic Games. The possibility of holding the 10th Winter Olympic Games generated a great amount of interest in the construction of sewerage as part of a total urban environment reconstruction program, and this was incorporated into the city policy. Sewerage construction was made one of the most important priorities in city policy because in 1963 a comprehensive sewerage plan which incorporated the construction and distribution of sewage treatment plants was set up. Therefore, prior to the 11th Winter Olympic Games, a high treated-sewage ratio was aimed at in the six-year sewerage construction and the first five-year plans. In other

**Table 4.** Trends in Share of the Source of Sewerage Construction Expenditures in Sapporo City (%)

	Government Subsidies	Bond Issues	Charge	City Expen -ditures	Others
1965	24.96	41.50	—	27.30	6.24
66	23.81	42.54	—	27.05	6.60
67	24.99	46.41	—	25.57	3.03
68	24.31	41.29	—	28.83	5.57
69	25.93	44.58	—	27.58	1.90
70	29.75	40.16	—	26.11	3.98
71	28.68	49.38	3.34	18.45	0.15
72	30.09	50.60	4.03	13.81	1.47
73	23.12	57.96	6.38	2.48	10.05
74	26.81	56.24	6.07	0.00	10.88
75	32.02	55.37	5.21	0.00	7.39
76	33.36	57.66	2.96	0.00	6.02
77	31.97	60.46	1.64	2.40	3.53
78	31.79	60.64	1.28	3.55	2.74
79	28.68	62.09	1.78	4.02	3.44
80	28.62	62.11	1.86	5.23	2.18
81	26.71	57.17	2.10	4.94	9.08
82	22.32	55.57	2.03	4.50	15.58
83	22.90	55.08	2.17	5.06	14.80
84	27.27	56.79	1.96	5.49	8.48
85	28.15	60.90	1.57	1.95	7.42
86	31.48	56.18	0.95	2.05	9.34

Source : Sapporo City, "Explanation of Accounting Settlement of Accounts", 1965-1986.



words, although the high treated–sewage ratio of this period was a goal established in planning, it was also a product of the recognition that the Winter Olympic Games would be held in Sapporo City.

Another factor which explains the rapid increase in treated–sewage ratio was the enforcement of the beneficiary charge system. This system refers to the charges borne by landowners due to the benefits obtained by them because of the increase in the value of their property as a result of the construction of public sewerage. These charges then constitute a part of the public sewerage construction funds. For those cities adopting this system, priority distribution of sewerage construction subsidies by the government were determined from the year that the system was employed. Government subsidies increased because of this system and thus, construction increased more than ever.

Next, let us consider the factors which explain the rapid increase in treated–sewage ratio from 1977 to 1981. The rise in the rate of government subsidies from 1974 is the primary factor. The rate of government subsidies for drain pipes and pumping stations rose from 4/10 to 6/10, for sewage treatment plants subsidies rose from 4/10 to 2/3. This policy had the aim of encouraging the further construction of sewerage. Subsidies for sewerage were increased to promote sewerage construction.

### 3. Sewerage Finance : Trends and Problems

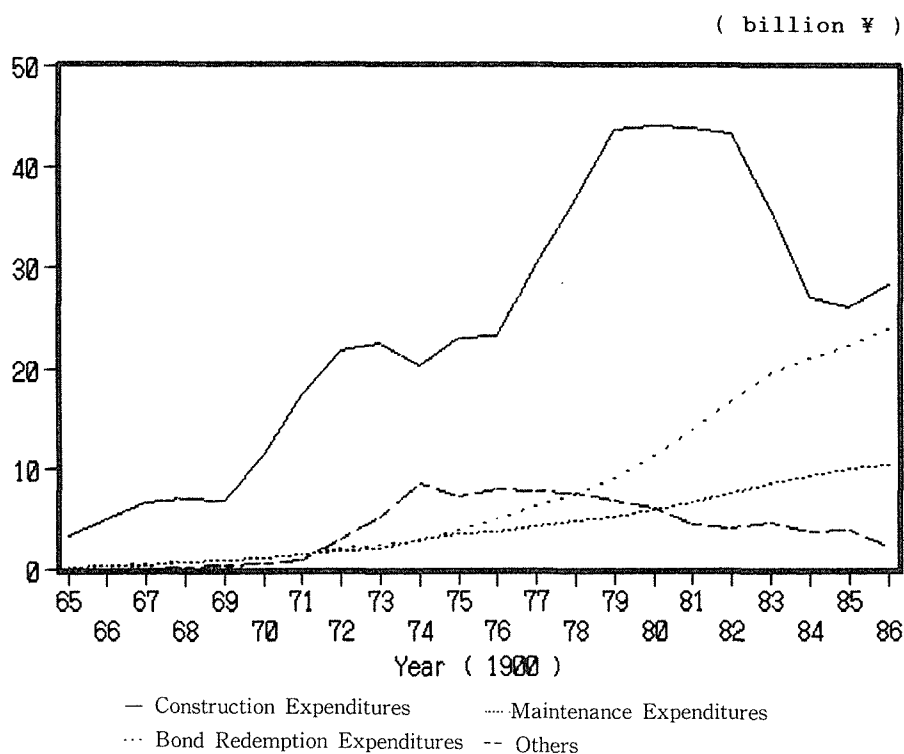
Sewerage works increased rapidly such that by 1981 the treated–sewage ratio reached the 90 percent level. As a result, the property value of sewerage works amounted to 307.1 billion yen by 1981, and this has led to the greater importance of sewerage works' maintenance and administration and management problems. Thus in 1982, an enterprise account and not a special account was adopted based on the laws of municipal enterprise. The fundamental principle adopted then was the self-supporting accounting system. There is a difference between enterprise accounts and special accounts is the bookkeeping system. Special accounts divide revenue and expenditures into ordinary expenditures (maintenance administration portion) and extraordinary expenditures (construction portion), while enterprise accounts divide profitable revenue and profitable expenditures, and capital revenue and capital expenditures.

In the subsequent section, the trends in sewerage finance by planning period will be examined in the order of expenditure items and their sources of funds.

#### 1) Trends in Sewerage Finance

Figures 2 and 3 show trends in sewerage revenue and expenditure settled accounts for Sapporo City, while Tables 5 and 6 show the share of revenue and expenditure items. Based on these figures, the trends in revenue and expenditures will be examined in the order of expenditure items and their sources of funds.

Construction expenses refer to drain pipes, pumping stations, and sewage treatment plant construction-related expenses. This type of expense directly causes increases in the treated–sewage ratio. Figure 2 shows that the trend for construction expenditures to



**Figure 2.** Trends in Sewerage Account Expenditures in Sapporo City.

Source : Sapporo City, "Explanation of Accounting Settlement of Accounts", 1965-1986.

Notes 1) Deflator used was the public sector of domestic gross fixed capital formation in the gross national expenditures based on the 1980 calendar year.

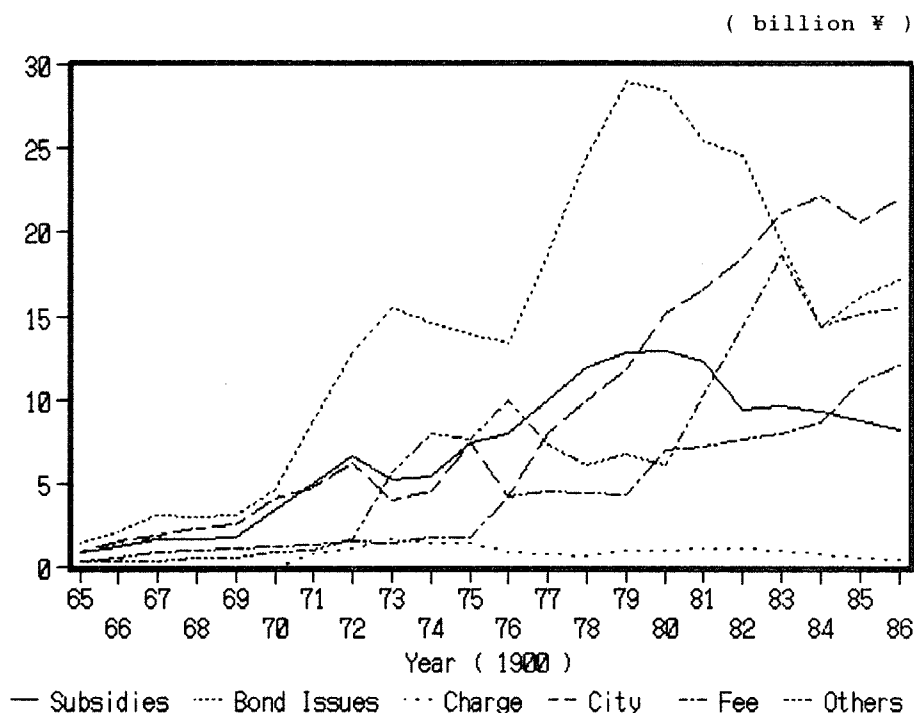
2) Details of construction expenditures : drain pipes, sewage treatment plants, reconstruction expenditures, personnel expenditures.

3) Details of maintenance expenditures : operation, repair and personnel expenditures.

4) Details of bond redemption expenditures : principal and interest on loans.

5) Details of others include flush toilet promotion related expenditures and repayment of the loans of general account.

increase rapidly occurred during 1969-1972 ( from the latter period of the six-year plan to the early period of the first five-year plan) and during 1976-1979 ( the second five-year plan period). The trend peaked in 1980 and it showed no remarkable fluctuations up to 1982. The subsequent trend was downwards but from 1986 the tendency has been upwards, that is increasing. Although an obvious fact, it should be noted that during those periods when construction expenses increased, the treated-sewage ratio also recorded significant increases. In 1983, when a downward trend started, the treated-sewage ratio had reached 90 percent which can be thought of as being nearly complete. The general trend for the share of construction expenses was for it to decline ; the figures show that although in 1965 the share was around 89 percent, in 1985 the share had dropped to 42 percent. In 1986 this share had started to increase again due to the need to construct more drain pipes and



**Figure 3.** Trends in Sewerage Account Revenues in Sapporo City.

Source : Sapporo City, "Explanation of Accounting Settlement of Accounts", 1965-1986.

Notes 1) Deflator used was the public sector of domestic gross fixed capital formation in the gross national expenditure based on the 1980 calendar year.

2) Subsidies from 1975-1983 include sewerage works special fund.

3) Bond issues from 1984 include provisional financial fund.

4) From 1982, for the data consistency depreciation cost was excluded.

5) Details of others include other burden accounts, contributions, construction burdens.

6) Charge refers to the revenue from the beneficiary charge system.

7) City refers to the expenditures of Sapporo City.

facilities as a measure to counteract flooding brought about by an increase in sewage quantity caused by the increase in rain water outflow, a result of urbanization. The flood countermeasure plan aims to expand drain pipes and pumping stations, and introduce run-off drainage control type sewerage. An amount equal to 79.3 billion yen has been allocated for this purpose in the budget plan for the next ten years starting from 1988. The major sources of construction funds are government subsidies and bonds. Figure 4 shows the share of these sources. Let us now consider the trend of government subsidies and bonds. Government subsidies are allocated to various works and facilities based on a particular rate of subsidy. Table 7 shows that since 1965 this subsidy rate has been fluctuating. In 1987, the subsidy rate was 5/10 for drain pipes, and 5.25/10 for sewage treatment plants. The overall trend for subsidies is quite similar to that for construction expenditures. However, from 1980 this trend showed some gaps.

**Table 5.** Share of the Sewerage Account Expenditures in Sapporo City (%)

	Construction	Maintenance	Bond Servicing	Others
1965	88.94	4.14	6.78	0.14
66	87.57	5.99	6.30	0.14
67	86.45	6.03	6.72	0.79
68	81.32	7.76	8.81	2.11
69	75.75	9.70	10.86	3.69
70	79.83	7.81	8.29	4.08
71	81.86	6.52	6.98	4.64
72	76.28	6.20	7.04	10.48
73	69.75	6.44	7.55	16.25
74	59.17	8.39	7.97	24.47
75	61.21	9.40	10.21	19.18
76	58.15	9.46	12.55	19.83
77	62.68	8.79	12.76	15.76
78	65.14	8.51	13.10	13.25
79	67.63	7.93	14.01	10.43
80	65.42	8.67	16.81	9.10
81	63.83	9.76	20.04	6.37
82	60.30	10.48	23.47	5.74
83	52.25	12.52	28.61	6.61
84	44.40	15.13	34.49	5.97
85	41.99	15.97	35.85	6.20
86	43.83	15.98	36.83	3.37

Source : Same as Figure 3.

**Table 6.** Share of the Sewerage Account Revenues in Sapporo City (%)

	Government Subsidies	Bond Issues	Charge	City Expen -ditures	Fee	Others
1965	22.17	36.86	—	23.02	8.66	9.29
66	20.72	37.03	—	26.42	9.96	5.87
67	20.85	39.19	—	24.28	11.71	3.97
68	19.69	34.80	—	27.34	12.09	6.08
69	19.39	34.38	—	27.63	12.64	5.96
70	23.73	32.61	—	28.73	8.74	6.19
71	23.07	40.74	3.39	22.17	6.14	4.49
72	22.30	42.86	3.68	20.56	5.00	5.60
73	15.57	46.38	4.92	11.90	4.23	17.00
74	15.20	40.85	3.98	12.68	4.93	22.36
75	18.71	35.17	3.62	18.77	4.51	19.22
76	19.49	32.88	2.24	10.44	10.47	24.48
77	20.28	37.96	1.47	16.19	9.21	14.89
78	20.75	42.65	1.21	17.21	7.71	10.48
79	19.48	44.23	1.53	18.00	6.54	10.23
80	18.35	40.18	1.46	21.46	9.90	8.67
81	16.80	34.92	1.58	22.73	9.89	14.09
82	12.47	32.47	1.45	24.48	10.10	19.03
83	12.37	24.92	1.27	27.26	10.31	23.87
84	13.42	20.68	1.04	31.86	12.35	20.65
85	12.12	22.36	0.84	28.41	15.32	20.95
86	10.82	22.75	0.62	29.22	16.05	20.53

Source : Same as Figure 3.

Drain Pipe, etc.		Sewage Treatment Plant	
Subsidized	Independent	Subsidized	Independent
Government Subsidies 6/10	Bond  9.5/10	Government Subsidies 2/3	Bond  9.5/10
Bond 3.4/10		Bond 2.83/10	
0.6/10		0.5/10	
Others ( Charge, City Expenditures etc. )			

**Figure 4.** Classification of the Sources of Construction Expenditure.

Source : From the Sapporo City Sewerage Department, "Sewerage of Sapporo City", 1989, p. 26.

Bonds are issued for construction expenses based on an appropriation rate. Since 1981, in the case of subsidy works, 85 percent of construction expenditures was shouldered by the local government and in the case of independent works, 95 percent was shouldered by the local government. The object of bonds are drainage, drain pipes, pumping stations, sewage treatment plants, and expenditures for land. Since 1985 the decrease in government subsidies was made up for by the issuance of government bonds. The trend was the same as that for construction expenses. From 1970-1973 and from 1977-1979, the trend was for bonds to show a rapid increase. However, a downward trend was observed from 1981 to 1984. As Table 4 shows it, the share of Bond issues in construction expenditure does not exhibit any similarity or relation to the trend of subsidies. Generally speaking, the trend for Bond issues shows that their share is expanding from around 40 percent to 60 percent. The cause of the increase in the share of bonds in 1978 can be traced to the increase in that the share of branch pipes which prompted more independent works and eventually greater city burden (Table 8). As shown in Figure 2, construction expenses maintained a high level from 1979 to 1982 but government subsidies and bonds decreased from 1981 to 1982. The reason for this was the increase in the loans from the city governments' general account and construction contribution which are accounted for in the category of other revenue items. (Table 6)

Maintenance and administration expenses are used for maintaining the functions of various facilities. Obviously, an increase in sewerage-related stocks will lead to an increase in the treated-sewage ratio. The trend for maintenance and administration expenses does not show any relation to the planning period but rather show that expenses are annually increasing. Their share in annual expenditures rose from 4 percent in 1965 to 16 percent in 1986, and thus the treated-sewage ratio rose to nearly complete. City expenditures and users fees are the sources of maintenance and administration expenses. Basically, rain water treatment-related expenses are shouldered by city expenditures while sewage-related expenses are borne by fees. Let us then consider city expenditures and fees.

City expenditures refer to the money transferred from the general accounts. Essen-

tially, city expenditures cover a part of maintenance and administration, and bond redemption expenses earmarked for rain water outflow as well as 1/2 of the domestic drainage-related sewage bond redemption expenses. However, city expenditures also bear a part of the construction expenses, ordinary revenue and expenditure deficiencies (1969 and 1971-1975), and that part of maintenance and administration expenses for sewage which can not be met by fees. Thus, actual city expenditures are greater than what is implied by their basic configuration. From 1977 city expenditures have shown an increasing trend. Concerning their share in revenues, it can be said that up until 1972 their share was high but eventually it decreased. The decrease, however, did not persist and from 1977 the share of city expenditures again began to increase. In recent years, this share rose to around 30 percent which is the biggest share among the revenue items.

Fees are levied to meet expenditures for sewage treatment. Fees show a remarkable increase in times of fee revision. Their share in annual revenue also increased from 9 percent in 1965 to 16 percent in 1986.

Finally, bond redemption refers to the amount of loan principal and interest. The greater the accumulation of bond issues is, the greater the increase in bond redemption. In

**Table 7.** Trends in the Rate of Government Subsidies for Sewerage Construction

	1965-66	1967-73	1974-84	1985	1986	1987
Drain Pipe and Pumping Station	1 / 3	4 / 10	6 / 10	5.5 / 10	5 / 10	5 / 10
Sewerage Treatment Plant	1 / 3	4 / 10	2 / 3	6 / 10	5.5 / 10	5.25 / 10

Source : Sewerage Administration Study Group ed., "Sewerage of Japan", Japanese Sewerage Association, 1987, p.142.

Note : Values for Tokyo, Yokohama, Kawasaki, Osaka, Kobe, Nagoya are 1/4 for the years 1965-1966.

**Table 8.** Share of Construction Expenditures for Main and Branch Pipes (%)

	Main Pipe	Branch Pipe
1973	73.7	26.3
74	71.8	28.2
75	69.0	31.0
76	70.8	29.2
77	72.2	27.8
78	66.9	33.1
79	56.2	43.8
80	56.2	43.8
81	62.6	37.4
82	61.3	38.7
83	52.3	47.7
84	59.8	40.2
85	60.7	39.3
86	57.8	42.2

Source : Same as Figure 3.

other words, the increase in bond redemption comes with an increase in the treated-sewage ratio. The balance of outstanding bond issues was only around 1.5 billion yen in 1965. However, in 1986 this rose to 238.3 billion yen, an enormous amount.

As for the trend for bond redemption, up until 1975 their share was the same as that of maintenance and administration expenses but after 1975 their share rapidly increased. Thus their share in annual expenditures rose from around 20 percent in 1981 to around 36.8 percent in 1986, an increase which made their share second to construction expenses.

## 2) Sewerage Financial Problems

Principally, sewerage financial problems will be examined by considering construction expenses, which are directly related to the increase in the treated-sewage ratio, and bond redemption which is the main source of financial problems. Moreover, sewerage financial problems will also be examined by looking into maintenance and administration expenses and their main source, that is city expenditures.

First let us consider the problems related to construction expenses. The treated-sewage ratio has reached nearly complete so that the share of construction expenses has decreased by almost 1/2. However, the total amount is still relatively large. Furthermore, due to the adoption of flood countermeasures, construction expenses began to increase again in 1986. Precisely because the rate of population increase of Sapporo City has been very rapid, construction expenditures cannot be reduced immediately. Accordingly, bonds will also increase from now on and city expenditures will be greater. Likewise, independent works by the city increased because from 1977 the share of branch pipes in construction expenses increased. This increased the city burden. Moreover, the continuing maintenance and administration expenses for rain water treatment have had to be met by city expenditures.

It is said that bond redemption is the biggest problem as far as sewerage finance is concerned. It is a fact that the primary objective of sewerage works is increasing the treated-sewage ratio. This calls for construction expenses, the source of which is bonds. Thus there is obviously a need to repay principal and interest on bonds made in order to attain the primary objective of increasing the treated-sewage ratio. However, even if the treated-sewage ratio has reached a very high level, construction expenditures may be foreseen to continue for a longer period of time. Accordingly, the balance of outstanding bond issues will increase further along with the share of principal and interest on bonds (1986: 30%). Excluding interest on temporary bonds and assuming that the amount of bonds for 1988 will be the same ten years later, it is projected that bond redemption in 1999 will reach 31.1 billion yen (nominal value). Comparing this with the 1986 value of 24.0 billion yen, bond redemption is projected to increase by 7 billion yen (excluding interest on short-term bonds), and in the case of a 1 percent increase in interest rate an additional burden of around 2.2 billion yen would have to be shouldered. In 1986 the city had to bear through money transfers and city expenditures around 2 percent of the total construction expenses, 31 percent of maintenance and administration expenses, and 65 percent of bond redemption. Therefore it is predicted that the main problem from here on will be the increasing burden that the city has to bear with further increases in construction expenses.

#### 4. CONCLUSION

Based on the results of the above examination, the trends in public sewerage works in Sapporo City show that from the six-year sewerage construction plan of 1965, four consecutive five-year plans were carried out with the fourth five-year plan being completed in 1987. Actual investment made in the period of the six-year plan and first five-year plan exceeded by more than 30 percent planned investment. Sewerage works proceeded at a rapid pace and with it the treated-sewage ratio also increased rapidly.

There are three causes for the rapid increase in the treated- sewage ratio of Sapporo City. 1) The bid to hold the 10th Winter Olympic Games and the consequent acceptance of the invitation to hold the 11th Winter Olympic Games encouraged the setting up of a construction plan as part of urban environment reconstruction. This plan was aimed at increasing the treated-sewage ratio. Thus, investments in treatment plant construction were intensively made. 2) In consonance with the invitation to hold and the actual opening of the 11th Winter Olympic Games, a sizable amount of city funds were allocated for Olympic-related drain pipe and sewage treatment plant construction. 3) The adoption of the beneficiary charge system led to the increase in government subsidies and the increase in government subsidy rates from 1974 contributed to the rapid rise in treated-sewage ratio.

Among the government-designated cities, the finances of Sapporo City are comparatively lower owing to the weak secondary industry and intense migration of poor or economically disadvantaged people to Sapporo City. However, since Sapporo City attaches importance to the natural and social environment, public sewerage for "clean air and clean water" is recognizably one of the most important policies. This has led to the issuance of large amounts of bonds for sewerage works and, consequently, Sapporo achieved the second highest treated-sewage ratio among the government-designated urban cities.

As a result the following problems related to sewerage finance can be given : 1) The achievement of high treated-sewage ratio has come about because of a amount of bonds for construction. This has caused bonds to increase. Moreover, since the outstanding balance of bond issues is quite enormous, it is foreseen that the share of principal and interest on bonds and redemption amounts will increase further. This requires greater city expenditures. 2) In spite of the almost complete sewerage works of Sapporo City, one of the problems related to public sewerage works is the recurrence in the increase in construction expenses starting from 1986 which was brought by the furtherance of flood countermeasures. In addition, there is the difficulty of immediately reducing construction expenses because of the rapid increase in the population of Sapporo City. 3) The increase in the share of branch pipes in construction expenses has led to the increase in independent city works which in turn has caused a greater financial burden. 4) The city has to cover maintenance and administration expenses for rain water treatment.

In considering public sewerage works, it is important to take into account the development process of the particular city in question, the city's long-term plan, and the relationship between public sewerage works and city policy as well as public sewerage works and



other public policies. Another major issue is the need to compare and clarify the distinct features of public sewerage works among Sapporo and other cities. This study, however, concentrated on the treated-sewage ratio and the revenue source problem of Sapporo City as a preliminary step to the consideration of the above issues in further studies.

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