7.1.3 Present State of Water Quality Regulations

"The Water Pollution Control Law" is related with the prevention of water contamination. The law can be outlined as follows:

1) Regulations on effluents discharged from plants and business establishments to public bodies of water

① Public bodies of water - Bodies of water such as rivers, lakes, sea areas, etc., put to public use

② Parties subject to regulations - Plants and business establishments which own specified facilities (facilities designated by the Law as discharging fouled water or wastewater which may damage human health and the living environment)

③ Effluent standards - Hazardous substances: 23 substances, including Cd, Pb, Hg, CN, Cr^{+6}, etc.
- Items of living environment: 16 substances, including pH, BOD, COD, SS, soluble iron, oil, etc.

④ Control measures - Notification of the establishment of specified facilities, order for plan modification, spot inspection, improvement order, penal regulations

2) Restriction of ground infiltration of effluents discharged by business establishments which use hazardous substances

In addition to the Water Pollution Control Law, the following laws related with the prevention of water contamination have also been instituted:

① Law relating to the prevention of marine pollution and maritime disasters (Regulations on oil and others)
② Sewage water law
③ River law
④ Law concerning special measures for conservation of lake water quality
⑤ Law concerning special measures for conservation of the environment of the Seto Inland Sea
⑥ Industrial water law (land subsidence)
⑦ Waste disposal and public cleansing law (prevention of water contamination relating to waste disposal)

7.2. Environmental Standards and Industrial Wastewater Standards

7.2.1. Environmental Standards

Based on the Environmental Basic Law, the government determines environmental standards for public water areas in order to protect the human health and preserve the living environment. Environmental standards regarding to the protection of human health (environmental standards concerning harmful substances) are shown in Table 7.2.1. These standards are applied throughout the country and were substantially strengthened and the scope of such increased in 1993, with the number of regulated substances increasing to 23.

Table 7.2.1 Environmental Quality Standards for the Protection of Human Health

Environmental Quality Standard for Human Health

Item	Standard value
Cadmium	0.01 mg/l or less
Total cyanide	Not detectable
Lead	0.01 mg/l or less
Chromium (hexavalent)	0.05 mg/l or less
Arsenic	0.01 mg/l or less
Total mercury	0.0005 mg/l or less
Alkyl mercury	Not detectable
PCB	Not detectable
Trichloroethylene	0.03 mg/l or less
Tetrachloroethylene	0.01 mg/l or less
Carbon tetrachloride	0.002 mg/l or less
Dichloromethane	0.02 mg/l or less
1,2-Dichloroethane	0.004 mg/l or less
1,1,1-Trichloroethane	1 mg/l or less
1,1,2-Trichloroethane	0.006 mg/l or less
1,1-Dichloroethylene	0.02 mg/l or less
cis-1,2-Dichloroethylene	0.04 mg/l or less
1,3-Dichloropropene (D-D)	0.002 mg/l or less
Thiram (TMTD) (bis (dimethylthiocarmoyl) disulfide)	0.006 mg/l or less
Simazine (CAT) (2-chloro-4,6 bis (ethylamino)-1,3,5-triazine)	0.003 mg/l or less
Thiobencarb (S-p-chlorobenzyl diethylthiocarbamate)	0.02 mg/l or less
Benzene	0.01 mg/l or less
Selenium	0.01 mg/l or less

Environmental standard values regarding the preservation of the living environment exist for designated waterways, lakes and marshes, and for the sea. These are classified with consideration being given to the way in which they are used. Environmental standards for waterways are shown in Table 7.2.2, and those for lakes and marshes are shown in Table 7.2.3, and Table 7.2.4 shows those for sea area.

Table 7.2.2. Environmental Quality Standards for Conservation of the Living Environment (River)

Category	Item / Purposes of water use	Standard values[1]				
		pH	Biochemical Oxygen Demand (BOD)	Suspended Solids (SS)	Dissolved Oxygen (DO)	Number of Coliform Groups
AA	Water supply class 1, conservation of natural environment and uses listed in A-E.	6.5 - 8.5	1 mg/l or less	25 mg/l or less	7.5 mg/l or more	50 MPN/100ml or less
A	Water supply class 2, Fishery class 1, bathing and uses listed in B-E.	6.5 - 8.5	2 mg/l or less	25 mg/l or less	7.5 mg/l or more	1,000 MPN/100ml or less
B	Water supply class 3, Fishery class 2, and uses listed in C-E.	6.5 - 8.5	3 mg/l or less	25 mg/l or less	5 mg/l or more	5,000 MPN/100ml or less
C	Fishery class 3, Industrial water class 1, and uses listed in D-E.	6.5 - 8.5	5 mg/l or less	50 mg/l or less	5 mg/l or more	
D	Industrial water class 2, Agricultural water[2], and uses listed in E.	6.0 - 8.5	8 mg/l or less	100 mg/l or less	2 mg/l or more	
E	Industrial water class 3, Agricultural water[2], conservation of the environment.	6.0 - 8.5	10 mg/l or less	Floating matter such as garbage should not be observed.	2 mg/l or more	

Notes : 1. The standard value is based on the daily average value. The same applies to the standard values of lakes and coastal waters.
2. At the intake for agriculture, pH shall be between 6.0 and 7.5, and dissolved oxygen shall not be less than 5 ppm. The same applies to the standard values of lakes.
3. Conservation of natural environment: Conservation of scenic spots and other natural resources.
4. Water supply class 1: Water treated by simple cleaning operation, such as filteration.
Water supply class 2: Water treated by normal cleaning operation, such as sedimentation and filteration.
Water supply class 3: Water treated through a highly sophisticated cleaning operation including pretreatment.
5. Fishery class 1: For aquatic life, such as Yamame (Oncorhynchus masou) and Japanese char (Salvelinus pluvius) inhabiting oligosaprobic water, and those of Fishery class 2 and 3.
Fishery class 2: For aquatic life, such as fish of the salmon family (Salmonidae) and sweetfish (Plecoglossus altivelis) inhabiting oligosaprobic water, and those of the Fishery class 3.
Fishery class 3: For aquatic life, such as carp (Cyprinus carpio) and crucian carp (Carassius auratus) inhabiting, β-mesosaprobic water.
6. Industrial water class 1: Water given normal cleaning treatment, such as sedimentation.
Industrial water class 2: Water given sophisticated treatment by chemicals.
Industrial water class 3: Water given special cleaning treatment.
7. Conservation of the environment: Up to the limits at which no unpleasantness is caused to people in their daily life including a walk by the riverside, etc.

Table 7.2.3. Environmental Quality Standards for Conservation of the Living Environment (Lakes)

i)

Category	Item / Purposes of water use	Standard values[1] pH	Chemical Oxygen Demand (COD)	Suspended Solids (SS)	Dissolved Oxygen (DO)	Number of Coliform Groups
AA	Water supply class 1, Fishery class 1, conservation of natural environment and uses listed in A-C.	6.5 - 8.5	1 mg/l or less	1 mg/l or less	7.5 mg/l or more	50 MPN/100ml or less
A	Water supply class 2 and 3, Fishery class 2, bathing and uses listed in B - C.	6.5 - 8.5	3 mg/l or less	5 mg/l or less	7.5 mg/l or more	1,000 MPN/100ml or less
B	Fishery class 3, Industrial water class 1, Agricultural water and uses listed in C.	6.5 - 8.5	5 mg/l or less	15 mg/l or less	5 mg/l or more	
C	Industrial water class 3, conservation of the environment.	6.0 - 8.5	8 mg/l or less	Floating matter such as garbage should not be observed.	2 mg/l or more	

Notes : 1. With regard to Fishery class 1, 2, and 3, the standard value for Suspended Solids shall not be applied for the time being.
2. See notes for rivers.
3. Fishery class 1: For aquatic life, such as kokanee salmon (Oncorhynchus nerka) inhabiting oligosaprobic lake type waters, and for those of fishery class 2 and 3.
Fishery class 2: For aquatic life, such as fish of the salmon group (Salmonidae) and sweetfish (Plecoglossus altivelis) inhabiting oligosaprobic lake type waters, and for those of the Fishery class 3.
Fishery class 3: For those aquatic lives, such as carp (Cyprinus carpio) and crucian carp (Carassius auratus) inhabiting eutrophic lake type waters.
4. Industrial water class 1: Water given normal treatment such as sedimentation.
Industrial water class 2: Water given sophisticated treatment such as chemical injection or special treatment.
5. Conservation of the environment: Up to the limit at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

ii)

Category	Item / Purposes of water use	Standard values Total nitrogen[2]	Total phosphorus[2]
I	Conservation of natural environment and uses listed in II-V.	0.1 mg/l or less	0.005 mg/l or less
II	Water supply classes 1, 2 and 3 (excluding special types) Fishery class 1, bathing and uses listed in III-V.	0.2 mg/l or less	0.01 mg/l or less
III	Water supply class 3 (special types), and uses listed in III-V.	0.4 mg/l or less	0.03 mg/l or less
IV	Fishery class 2, and uses listed in V.	0.6 mg/l or less	0.05 mg/l or less
V	Fishery class 3, Industrial water, Agricultural water, conservation of the living environment.	1 mg/l or less	0.1 mg/l or less

Notes : 1. Standard values are set in terms of annual averages.
2. Standard values for Total nitrogen are applicable to lakes and reservoirs where nitrogen is a causal factor of the growth of phytoplankton.
3. Standard values for Total phosphorus are not applicable to agricultural water uses.
4. Conservation of natural environment: Conservation of scenic points and other natural resources.
5. Water supply class 1: Water treated by simple cleaning operation, such as filteration.
Water supply class 2: Water treated by normal cleaning operation, such as sedimentation and filteration.
Water supply class 3: Water treated through a highly sophisticated cleaning operation including pretreatment. ("special types" mean water treatments by special cleaning operation in which removal of smelling substances is possible).
6. Fishery class 1: For aquatic life, such as fish of the salmon group (Salmonidae) and sweetfish (Plecoglossus altivelis), and for those of Fishery class 2 and 3.
Fishery class 2: For aquatic life, such as smelt and those of Fishery class 3.
Fishery class 3: For aquatic life, such as carp (Cyprinus carpio) and crucian carp (Carassius auratus).
7. Conservation of the environment: Up to the limits at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

Table 7.2.4. Environmental Quality Standards for Conservation of the Living Environment (Sea Area)

Coastal waters

Category	Item / Purposes of water use	Standard values[1]				
		pH	Chemical Oxygen Demand (COD)	Dissolved Oxygen (DO)	Number of Coliform Groups	N-hexane extracts
A	Fishery class 1, bathing, conservation of natural environment, and uses listed in B-C.	7.8 - 8.3	2 mg/l or less	7.5 mg/l or more	1,000 MPN/100ml or less	Not detectable
B	Fishery class 2, Industrial water and uses listed in C.	7.8 - 8.3	3 mg/l or less	5 mg/l or more		Not detectable
C	Conservation of the environment	7.0 - 8.3	8 mg/l or less	2 mg/l or more		

Notes : 1. With regard to the water quality of fishery, class 1 for cultivation of oysters, number of coliform groups shall be less than 70 MPN/100ml.

2. Conservation of natural environment: Conservation of scenic points and other natural resources.

3. Fishery class 1 : For aquatic life, such as red sea bream (Chrysophrys major), yellow tail (Seriola quinqueradiata), seaweed (Undaria pinnatifida) and for those of Fishery class 2.

   Fishery class 2 : For aquatic life, such as gray mullet (Mugil cephalus), laver (Porphyra tenera), etc.

4. Conservation of the environment: Up to the limits at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

7.2.2 Wastewater Standards

Based on the Water Pollution Control Law, wastewater standards are determined for wastewater discharged from factories etc. Discharge standard values for harmful substances contained in discharged wastewater are determined for each type of harmful substance, as shown in Table 7.2.5. Permissible limits are also determined for other pollutants in order to preserve the living environment and also included in Table 7.2.6.

Table 7.2.5. Emission Standards Related to Human Health (Harmful Substances)

Harmful substance	Standard value
Cadmium and its compounds	0.1 mg of Cd per liter
Cyanides compounds	1 mg of CN per liter
Organic phosphorus compounds (Limited to Parathion, Methyl Parathion, Methyl Demeton and EPN)	1 mg/l
Lead and its compounds	0.1 mg of Pb per liter
Chromium (hexavalent) compounds	0.5 mg of Cr (VI) per liter
Arsenic and its compounds	0.1 mg of As perliter
Total mercury	0.005 mg of Hg per liter
Alkyl mercury compounds	Not detectable
PCB	0.003 mg/l
Dichloromethane	0.2 mg/l
Carbon tetrachloride	0.02 mg/l
1,2-Dichloroethane	0.04 mg/l
1,1-Dichloroethylene	0.2 mg/l
cis-1,2-Dichloroethylene	0.4 mg/l
1,1,1-Trichloroethane	3 mg/l
1,1,2-Trichloroethane	0.06 mg/l
Trichloroethylene	0.3 mg/l
Tetrachloroethylene	0.1 mg/l
1,3-Dichloropropene (D-D)	0.02 mg/l
Thiram (TMTD) (bis (dimethylthiocarmoyl) disulfide)	0.06 mg/l
Simazine (CAT) (2-chloro-4,6 bis (ethylamino)-1,3,5-triazine)	0.03 mg/l
Thiobencarb (S-p-chlorobenzyl diethylthiocarbamate)	0.2 mg/l
Benzene	0.1 mg/l
Selenium	0.1 mg/l

Table 7.2.6. Emission Standards Relating to the Living Environment

Pollutant	Standard value
pH (Hydrogen ion concentration-Hydrogen exponent)	Effluents discharged in public use water areas other than the sea : from 5.8 to 8.6 Effluents discharged in the sea : from 5.0 to 9.0
BOD (Biochemical Oxigen Demands)	160 mg/l (Daily average 120 mg/l)
COD (Chemical Oxigen Demands)	160 mg/l (Daily average 120 mg/l)
SS (Suspended Solids)	200 mg/l (Daily average 150 mg/l)
N-hexane extracts (content of mineral oils)	5 mg/l
N-hexane extracts (content of animal and vegetable oils and fats)	30 mg/l
Phenols	5 mg/l
Copper	3 mg/l
Zinc	5 mg/l
Soluble iron	10 mg/l
Soluble manganese	10 mg/l
Chromium	2 mg/l
Fluorine	15 mg/l
Number of coliform groups	3000 (Daily average)
Nitrogen	120 mg/l (Daily average 60 mg/l)
Phosphorus	16 mg/l (Daily average 8 mg/l)

Notes : 1. The emission standard is applied to each drain outlet leading to public waters.
2. Waste water emission standard concerning the living environment is applied to waste water of factories or companies whose daily average waste water discharge is over 50 m^3.

7.2.3 Pollutant Load Control Standards

Due to the concentration of the population and of industry, and the fact that large volumes of water are being released into semi-closed water areas from domestic and industrial activities, pollutant load control standards have been being enforced since 1979 in areas where wastewater discharge standards alone would not have been sufficient for the COD to meet the environmental standards (Tokyo Bay, Ise Bay, the Seto Inland Sea are designated as such). Based on the total pollutant load reduction plans determined by prefectures discharging such water into the sea or prefectures upstream from such, the total COD discharge volume is determined for each establishment by type of industry by calculating the volume of process wastewater (contaminated discharge water with the exception of indirect cooling water) together with the concentration determined in the total pollutant load control standards.

7.3. The Role of Local Public Bodies

In accordance with the Water Pollution Control Law, various responsibilities and powers are given to prefectural governors in order to ensure that water pollution control is being carried out in an effective manner in keeping with the characteristics of each area. The main responsibilities and powers of prefectural governors are shown below.

1) The setting of stricter standards

In accordance with the provisions of the Water Pollution Control Law, when there are water areas in which it is acknowledged that the wastewater standards set by the state are considered to be inadequate to protect the health of humans or to protect the living environment, prefectural governors may set stricter wastewater standards by way of prefectural ordinance.

2) Examination of notification to establish specific facilities and planning alteration orders

Enterprisers discharging water from factories into public water areas must submit details regarding such to the prefectural governor when establishing specific facilities or making changes to the structure of such. Prefectural governors may examine the content of such notifications and, if it is acknowledged that there is a possibility that wastewater contamination from such factory may exceed emission standards, order to revise the original plant for the planner's compliance.

3) On-site inspections

Prefectural Governors may enter factories, examine the state of operations of specified facilities and wastewater contamination data, and may take samples from wastewater. In cases where wastewater standard values are exceeded in such samples of wastewater, the Prefectural Governor may take measures such as issuing improvement orders etc. and where such orders are not complied with, may order to stop the factory operation, the levying of penalties, and imprisonment etc. of those responsible for such. The frequency of such inspections may be as often as once per month or as seldom as once a year.

4) The monitoring and testing of public water areas

The monitoring of the state of contamination of water in public water areas is an important aspect of water quality preservation administration. The aim of water quality preservation is reaching and maintaining environmental levels. In order to do so, the Water Pollution Control Law determines that Prefectural Governors are required to carry out regular monitoring of the state of contamination of public water areas. In Japan, monitoring plans which include test items, test areas, and testing methods, etc. are formulated by negotiation with the state and tests are carried out in accordance with such plan in order to ensure that constant monitoring is carried out uniformly and comprehensively.

7.4 Transitions of Land Subsidence and Countermeasures

7.4.1 Transitions of Land Subsidence

1) History of land subsidence

It is not known when land subsidence first started in Japan, but it was first confirmed when projects were undertaken in the 1920's to level areas in the lower parts of Tokyo and the littoral area of Osaka City. The land subsidence accelerated in the subsequent years, extending from beyond the city areas by the 1930's.

By the outbreak of the Pacific War in 1941, the land subsidence had slowed down somewhat, and a relatively stable condition was maintained until about 1950. This slowdown was attributable to the decreased amounts of groundwater pumped up due to the decreased industrial activity during the war. In the 20 to 25 years leading up to the war, the accumulated land subsidence reached about 2.5m in Tokyo Metropolis, 1.3m in Kawasaki City, and 1.7m in Osaka City. Although the land subsidence was clearly the cause of substantial damages, there was no acknowledged link between the pumping up of groundwater and land subsidence at that time, and no measures were taken to regulate the usage of groundwater.

When production activities were reanimated at the start of the 1950's, land subsidence resumed its former pace, and the pumping up of groundwater was finally _acknowledged as the primary culprit.

From that time on, laws were enacted to regulate excessive pumping-up of the groundwater. As a result, land subsidence slowed down in the areas which had been most seriously affected around Tokyo Metropolis and Osaka City.

In the areas where such laws were not enacted promptly, intense land subsidence continued even into the 1970's. The most evident example is the annual land subsidence of 273mm recorded in the Tokorozawa City of Saitama Prefecture (about 30km northwest of the center of Tokyo Metropolis.)

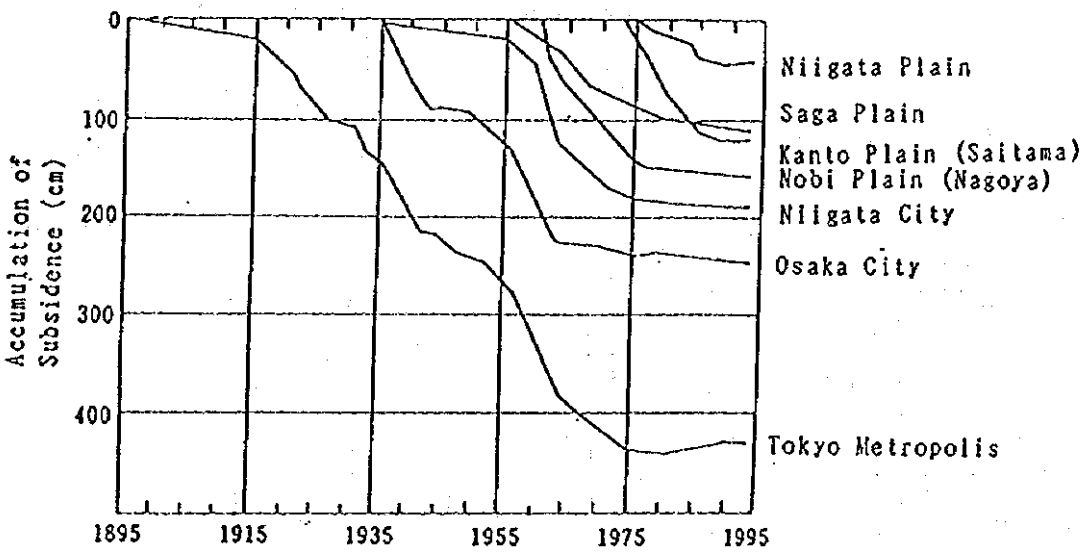
Transitions of land subsidence conditions are indicated in Table 7.4.1 and Fig. 7.4.1.

Table 7.4.1 Change of Land Subsidence Areas Unit : km²

Year / Subsidence Area & Zones	1980	1985	1990	1991	1992	1993	1994
Above 2 cm/year	467 (23)	499 (19)	360 (18)	467 (17)	525 (19)	276 (11)	902 (21)
Above 4 cm/year	100 (8)	40 (7)	14 (5)	6 (4)	25 (6)	0.5 (1)	113 (6)

Note: A number in ( ) means number of Subsidence zones.

Fig.7.4.1 Accumulated Subsidence of Main Zones



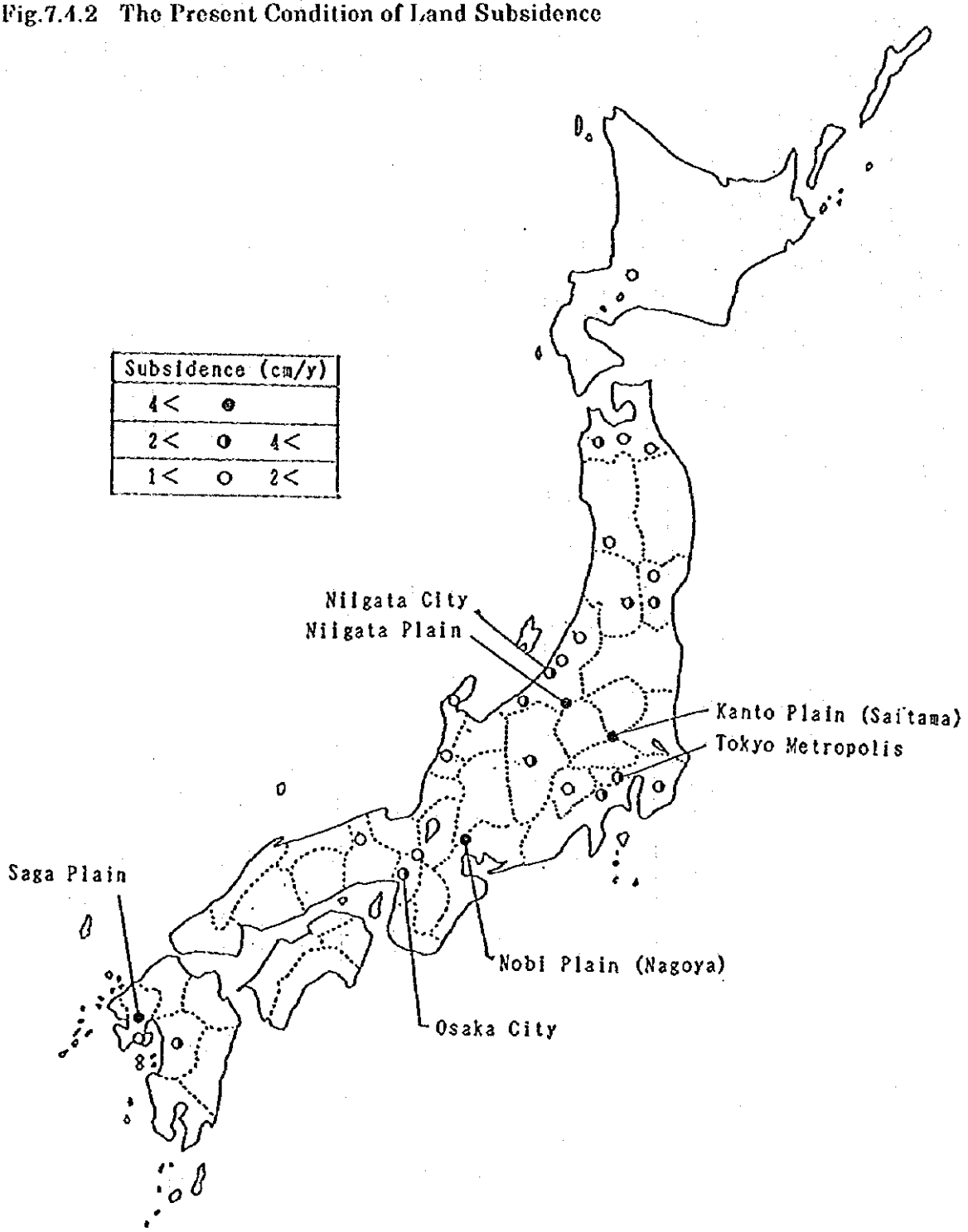
2) Present condition of land subsidence

Present condition of land subsidence is indicated in Fig. 7.4.2.

As shown on this figure and in Table 7.4.1, land subsidence in 1994 exceeded that of 1993 to a remarkable extent.

This sudden acceleration in land subsidence was attributable to the large quantities of groundwater pumped up to replace the river water which had dried up in the course of the year. As there were no droughts in 1995 and 1996, it is estimated that land subsidence will remain at the level of 1993.

Fig.7.4.2 The Present Condition of Land Subsidence



7.4.2 Measures to Prevent Land Subsidence

1) Laws and ordinances to prevent land subsidence

(1) Industrial water law

Object: Wells from which industrial water is pumped up
Areas: Covers the areas which suffer intense land subsidence and use large quantities of industrial water. Currently 10 prefectures, 1,950km².
Condition: Abundant and cheap substitute water (river water for the most part) should be available, so the installation of industrial waterworks is requisite.
Management of wells: When industrial waterworks are installed, the use of wells is prohibited.

(2) Law concerning regulation of pumping-up of groundwater for use in buildings

Object: Water for use in buildings (for air conditioning, flush toilets, washing, baths, etc.)
Areas: Covers areas which may suffer damages caused by storm surges and floods due to land subsidence. Currently 4 prefectures, 1,597km².
Condition: Availability of substitute water is not conditioned. Generally, tap water is used as a substitute.
Management of wells: With the enactment of the law, the use of wells is prohibited.

(3) Ordinances of prefectures

In addition to the areas where the two aforementioned laws are enforced, pumping-up of the groundwater is regulated by ordinances in 25 prefectures. Although the contents of the ordinances vary, they can be generally outlined as follows:

Designated use: Use of groundwater for industry, buildings, and agriculture. In many cases, use is limited to industry and buildings.
Designated areas: Areas which suffer or may suffer land subsidence, intrusion of salt water into the groundwater, and lowering of the groundwater level.
Designated wells: Wells whose delivery ports have cross-section areas larger than a fixed area (usually 6cm²)
Regulations on wells: Notification system for wells, permission system for wells, prohibition of digging new wells, etc.
Regulations on pump discharge: Installation of water meters, reporting on pump discharge, regulations on pump discharge, etc.

(4) Ordinances of municipalities

The pumping of groundwater is regulated by ordinances in 273 municipalities in 34 prefectures. The contents of the ordinances are generally in accordance with those of prefectures. As an exception, it is obligatory in Kumamoto City to install cooling towers for cooling or controlling the temperature of water.

2) Administrative guidance

As for the well water used for industry, The Ministry of International Trade and Industry and prefectures direct individual plants to decrease pump discharge (rationalized use) in specified areas.

"Guidance for the rationalized use of industrial water" is enforced by the Ministry of International Trade and Industry in 36 areas all over the country, and about 1,200 plants are required to decrease pump discharge.

7.5. Pollution Control Systems

7.5.1. System of Pollution Prevention Controller

The Water Pollution Control Law and the Air Pollution Control Law, etc. were enacted by the Pollution Diet of 1970 and the scope and strength of pollution control regulations was increased. However, there was a great gap between the strengthened regulations and the pollution control at factories being regulated by such. On account of this the Law for Establishment of Organization for Pollution Control Specified Factories was enacted in 1971 whereby factories which are a source of contamination are required to establish a system of pollution control in order to comply with the strengthened regulations.

The main points of this law are shown below.

1) Factories covered by this law (hereafter referred to as specified factories)

Those factories which establish facilities discharging waste water etc. as determined under the provisions of the Water Pollution Control Law. In addition to these, those factories which establish facilities as determined under the provisions of related laws with regard to the air, noise, vibration, and particulates.

2) Outline of organization

The organization required of specified factories is as follows.

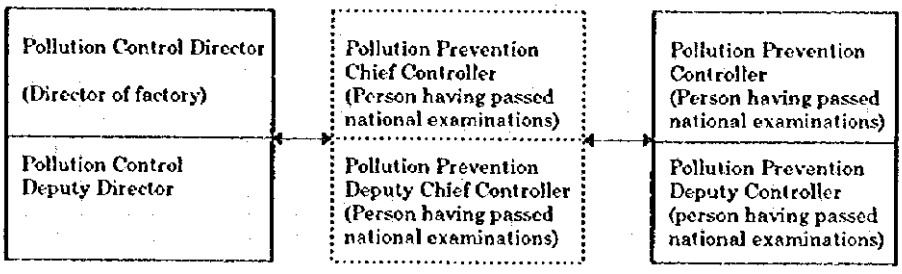
① Specified factories shall appoint a pollution control director to be in charge of pollution control measures. General superintendent of factory is usually appointed as such.

② Specified factories shall appoint a pollution prevention controller to be in charge of the technical aspects of pollution control measures. Pollution prevention controller must have more than a certain level of knowledge and experience, and must have passed national examinations.

③ In factories of more than a certain size, a pollution prevention chief controller shall be appointed to assist the pollution control director and to oversee pollution prevention controller. The pollution prevention chief controller must have more than a certain level of knowledge and experience, and must have passed national examinations.

Fig. 7.5.1. shows a typical organization of the pollution control in factories

Fig. 7.5.1 Organization of Pollution Control Management in Factories



Further, the appointed pollution control director, Pollution prevention controller, and their proxies must submit reports to the prefectural governor. Should transfer of personnel occur, such matters must be submitted in writing to the prefectural governor.

3) Duties

(1) The duties of the pollution control director

The pollution control director oversees pollution prevention controllers to ensure that they carry out their activities correctly, and takes measures to ensure that sufficient funds are available to carry out such. The main water quality control activities of pollution control directors are shown below.

① Observation of the use of contaminated water facilities, and matters regarding the maintenance of processing facilities etc.
② Matters regarding the monitoring and recording of wastewater to ascertain contamination levels.
③ Matters regarding measures to be taken in emergencies and should accidents occur.

(2) The duties of pollution prevention controllers

Under the supervision of the pollution control director, pollution prevention controllers manage technical matters regarding pollution control. The main water quality control activities of pollution prevention controllers are shown below.

① The inspection of raw materials utilized.
② The inspection of facilities discharging contaminated water.
③ The operation, monitoring, and repair of wastewater processing facilities.
④ The carrying out of monitoring of the state of contamination of discharged wastewater and the recording of results.
⑤ The inspection and repair of testing equipment.
⑥ The implementation of measures for coping with emergencies and accidents.

7.5.2. Incentives regarding the Location of Pollution Control Equipment

An exhaustive review and strengthening of environment-related laws was undertaken as a way to combat industrial pollution throughout the 1960s and 70s. In addition, industry also became involved in pollution control measures. However, this did not merely involve investment in equipment or the establishment of processing facilities, but also included the improvement and refurbishing of production facilities, together with the construction of new facilities. Therefore, enterprises needed incredible amounts of finance in order to comply with pollution control measures. The state increased and strengthened supporting systems for equipment investment for pollution control, which played a significant role in promoting pollution control measures.

There are two kinds of supporting systems: loans and tax incentives.

1) Loans

Low interest loans from government financial institutions exist for Small and Medium-sized Enterprises and Large Enterprises. Presently, loans are given for pollution control facilities, transfer to non-polluting facilities, and facilities efficiently using raw materials, etc. The main loans being given to water quality-related facilities are shown in Table 7.5.2.

Table 7.5.2. Loans Related to Water Pollution Control

Purpose of Loan	Facility
Pollution Control Measures	Polluted Water and Waste Liquid Processing Facilities Facilities for the Rationalization of Industrial Water Use
Effective Use of Resources	Facilities for the Effective Use of Water Resource

2) Tax incentives

State tax and local tax incentives exist for pollution control-related investment and are shown in Table 7.5.3.

Table 7.5.3. Outline of Tax Incentives for Pollution Control Investment by Enterprises

Tax	Tax Incentives	Outline
State Tax	Shortening of the service life of pollution control facilities.	Special shortening of the stated service life of pollution control facilities different from that of standard depreciation.
	Special depreciation of pollution control facilities.	A one time only large-sum depreciation allowed in the fiscal year in which pollution control facilities are acquired in order to ease the burden on enterprises from corporation tax. Special depreciation of 1/2 for first year depreciation was permitted in 1973, and 18/100 in 1995.
	Special depreciation for non-polluting production facilities.	Special depreciation of 1/3 for first year depreciation was permitted in 1973. This system has since been discontinued.
	Pollution preparation fund.	Enterprisers belonging to industry types approved by the Minister of Finance are permitted to save 3% of total income. This system has since been discontinued.
Local Tax	Tax exemptions for fixed property tax.	In 1970, most pollution control facilities qualified for tax exemption. Presently, only polluted water treatment plants and soot and smoke treatment facilities continue to qualify for such exemptions.

7.5.3. Environmental Monitoring by means of the Environmental Measuring Network

Constant monitoring of the water quality in public water areas provides important data for water quality administration. The constant monitoring of the water quality in public water areas is determined to be the responsibility of prefectural governors and the mayors of cabinet designated cities in accordance with the Water Pollution Control Law. However, as the monitoring of water quality costs large amounts of money, in accordance with the Water Pollution Control Law, the Environment Agency provides local public entities with a portion of necessary expenses in order to carry out this constant monitoring. This constant monitoring is carried out on waterways, lakes and marshes, and the sea classified in environmental standards.

In addition, in order to strengthen constant monitoring activities, the automation of water quality monitoring is being encouraged in important areas of public water areas. As of FY1992, automated monitoring was being carried out at approximately 300 locations.

7.5.4 Environmental Impact Assessment Systems

1) Types of environmental impact assessment

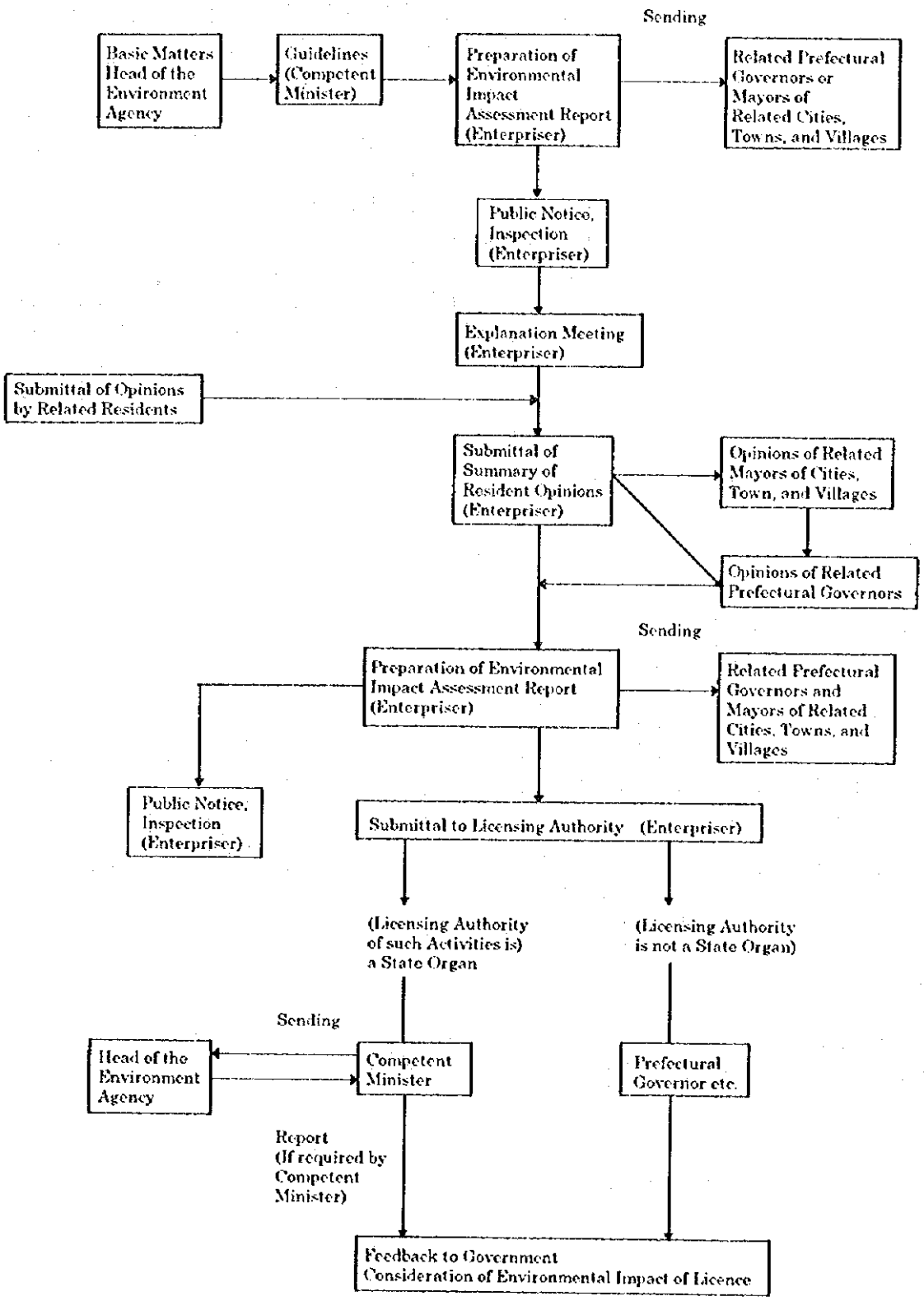
(1) Environmental impact assessment system based on cabinet resolution

The cabinet resolution is to determine a uniform rule by which environmental impact assessment can be carried out regarding large-scale activities in which the state is involved. State administrative organs carry out environmental impact assessment with regard to such activities at the planning stage. Such activities are shown in Table 7.5.4 and the process of such is shown in Fig. 7.5.2.

Table 7.5.4 Activities Based on Cabinet Designated Environmental Impact Assessement

	Assessed Activities
1.	Construction and improvement of expressways and ordinary roads etc.
2.	Construction of dams, and other waterways construction, in accordance with the provisions of the Waterways Law.
3.	Construction and improvement of railways.
4.	Construction of airports and the alteration of facilities.
5.	Land reclamation through filling in or drainage.
6.	Land readjustment activities carried out in accordance with the provisions of the Land Readjustment Law.
7.	New residential area development activities as determined in the New Residential Area Development Law.
8.	Industrial park formation activities as determined in the Law regarding the Redevelopment of Suburbs surrounding Metropolitan Areas and Town Development Areas, and industrial park formation activities as determined in the Law regarding the Redevelopment of Suburbs in the Kinki Area and Town Development Areas.
9.	New city foundation development activities as determined in the New City Foundation Development Law.
10.	Distribution park formation activities carried out in accordance with the provisions of the Law regarding the Formation of Urban Distribution Areas.
11.	Preparation of land for residential, industrial, and commercial use by legal entities established in accordance with special laws.
12.	Other activities, in addition to those raised in 1 to 11 above, as determined by the competent minister in negotiation with the Head of the Environment Agency.

Fig. 7.5.2 Structure and Flow of Procedures for Environmental Impact Assessment



The environmental factors to be investigated, estimated, and evaluated are determined in accordance with the state guideline.

① Factors regarding pollution control
Air pollution, water pollution, soil pollution, noise, vibration, land subsidence, and offensive odor.

② Matters regarding the preservation of the natural environment
Land form, soil quality, vegetation, wildlife, scenery, outdoor recreation.

(2) Environmental impact assessment system for activities under the jurisdiction of government ministries and agencies.

The related government ministries and agencies which have jurisdiction over the activities determined by cabinet resolution each have implementation guidelines regarding such activities. The main implementation guidelines are shown below in Table 7.5.5.

Table 7.5.5. Outline of Environmental Impact Assessment by Ministry and Agency

Ministry/Agency	Ministry of Construction	Ministry of Transport	Ministry of Health and Welfare	Ministry of International Trade and Industry	Environment Agency
Title	Items requiring environmental impact assessment concerning activities under the jurisdiction of the Ministry of Construction.	Items requiring environmental impact assessment concerning large-scale activities under the jurisdiction of the Ministry of Transport.	Items requiring environmental impact assessment concerning activities under the jurisdiction of the Ministry of Health and Welfare.	Items requiring environmental impact assessment concerning activities under the jurisdiction of the Ministry of International Trade and Industry.	Items requiring environmental impact assessment concerning activities under the jurisdiction of the Pollution Control Agency.
Date of Enactment	April 1, 1985	April 26, 1985	December 12, 1985	November 16, 1985	April 20, 1985
Activities	① Construction and improvement of state expressways. ② Construction and expansion of ordinary state roads, and construction of by-passes (of more than 4 lanes). ③ Construction and improvement of expressways in the capital, Hanshin region, and designated cities. ④ Construction of dams on class 1 rivers (flooded area of more than 200ha). ⑤ Development of lakes and marshes, and the construction of drainage canals (land improvement area of more than 100ha). ⑥ Land reclamation through filling in or draining (reclaimed land of more than 50ha). ⑦ Land redevelopment activities (areas of more than 100ha). ⑧ Development of new residential areas (area of more than 100ha). ⑨ Preparation of industrial parks (areas of more than 100ha). ⑩ Preparation of the foundation of new cities (areas of more than 100ha). ⑪ Preparation of parks for distribution activities (areas of more than 100ha). ⑫ Preparation of residential land in accordance with the Residential and Urban Maintenance Corporation Law (areas of more than 100ha). ⑬ Preparation of land in accordance with the Law regarding the Promotion and Maintenance of Local Areas (areas of more than 100ha).	① Construction of the new main trunk line (Shinkansen). ② Construction of airports. • Construction of airports with runways of more than 2,500m. • Addition of runways of more than 2,500m. • Extension of runways by more than 500m where the total completed length of the runways will be more than 2,500m. ③ Land reclamation through filling in or drainage (areas of more tha 50ha).	① Construction of dams on class 1 rivers with a flooded area of more than 200ha for water supply purposes (with the exception of multi-purpose dams etc. not under the jurisdiction of the Ministry of Health and Welfare). ② Construction of final disposal sites for general waste and industrial waste (land fills of more than 30ha or those changed to be more than 30ha).	① Construction of dams on class 1 rivers with a flooded area of more than 200ha (for industrial water use). ② Land preparation of more than 100ha, for industrial park use, in accordance with article 19 section 1 paragraph 3 of the Promotion and Maintenance of Local Areas Corporation Law. ③ Land preparation of more than 100ha, for coal mining industrial park use, in accordance with article 19 section 1 paragraph 4 of the Promotion and Maintenance of Local Areas Corporation Law.	① Preparation of land for joint pollution control facilities (areas of more than 100ha). ② Preparation of land for factory transfer activities (areas of more than 100ha).
Items for Testing and Evaluation	①~③ Water pollution (BOD or COD, SS), noise, vibration, land subsidence, land form and soil quality, vegetation, animals, and scenery. ④ Water pollution (BOD), land form and soil quality, vegetation, animals, and scenery. ⑤ Water pollution (BOD or COD), land subsidence, land form and soil quality, vegetation, animals, and scenery.	② Air pollution (SO_2, NO_2, CO, SPM, Ox), water pollution (BOD, COD, SS, n-Hx, T-N, T-P), noise, vibration, land form and soil quality, vegetation, animals, and outdoor recreation, etc.	① Water pollution (BOD), land form and soil quality, vegetation, animals, scenery, and outdoor recreation, etc. ② Air pollution (SO_2, NO_2, CO, SPM), water pollution (BOD or COD, SS or degree of pollution, (T-N), (T-P), (metals)), noise, vibration, offensive odor, land form and soil quality, vegetation, animals, scenery, and outdoor recreation, etc.	① Water pollution(BOD), land form and soil quality, vegetation, animals, scenery, and outdoor recreation, etc. ②③ Air pollution (SO_2, NO_2, CO), water pollution (BOD or COD, (SS), (N), (P)), noise, vibration, land subsidence, land form and soil quality, vegetation, animals, scenery, and outdoor recreation, etc.	①② 1,2. Air pollution (SO_2, NO_2, CO), water pollution (BOD or COD, SS, (T-N), (T-P)), soil contamination, noise, vibration, land subsidence, offensive odor, land form and soil quality, vegetation, animals, scenery, and outdoor recreation, etc.

(3) Environmental impact assessment system of local self-governing bodies

The environmental impact assessment system prescribed by national guidelines is applied to large-sized undertakings involving the national government. For undertakings involving local self-governing bodies and private enterprises, environment impact assessment systems are set up individually by the ordinances and guidelines of the local self-governing bodies. Types and sizes of the objective undertakings are determined by local self-governing bodies depending on the circumstances of the areas. For example, for the construction of a plant, the size is determined on the basis of the site area, drainage volume, and gas emission volume. Undertakings whose sizes exceed the determined size require prior environmental impact assessment. The flow of procedures for environmental impact assessment is almost the same as that indicated in Fig. 7.5.2.

7.6 Private Enterprise Environmental Management Systems

7.6.1 Environmental Management System in Private Enterprises

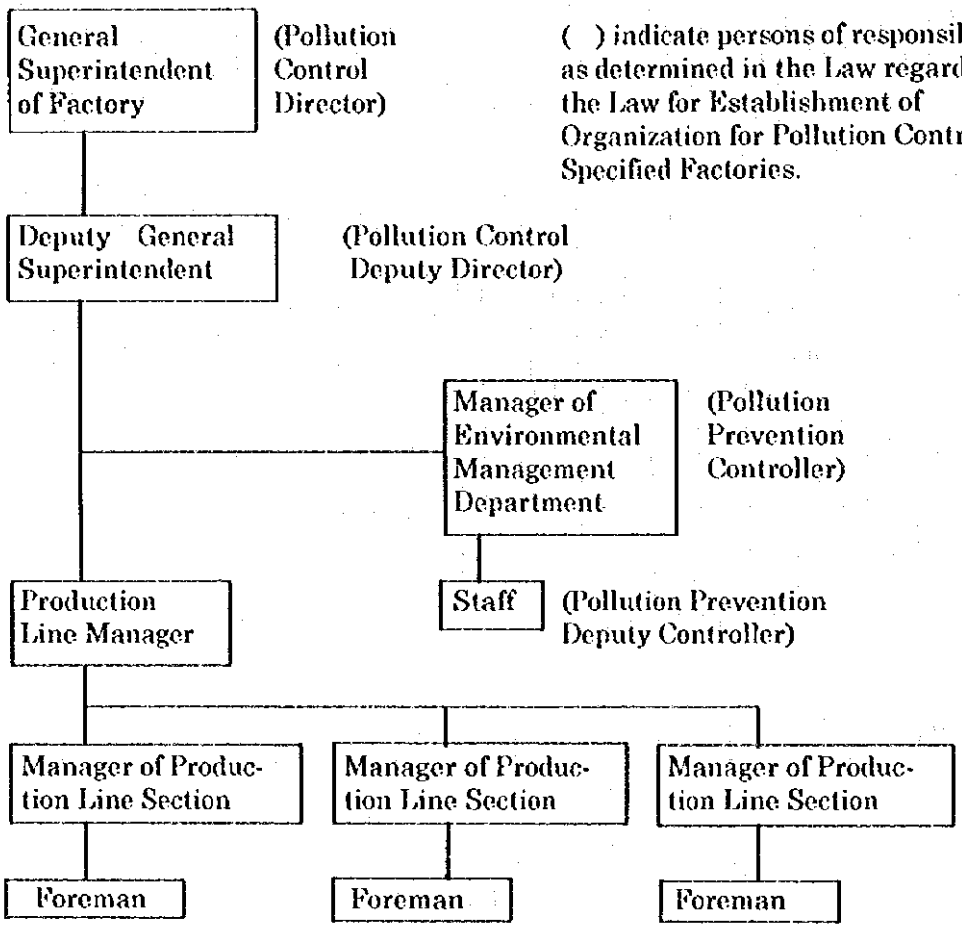
In order to comply with the Basic Law for Environmental Pollution Control enacted in 1967 and the environmental laws and regulations which were strengthened and the scope of which was enlarged on account of the Pollution Diet of 1970, many Japanese enterprises organized environmental management systems not only in factories but also in head offices, in addition to appointing Pollution Control Directors in accordance with the law.

Special environmental departments were established in factories, in addition to an environmental committee which deliberates and makes decisions regarding the environmental problems of the factory. The factory manager is appointed as head of the environmental committee for the following reasons.

① As a company, decision-making from the top-down is essential in order to achieve environmental management goals.
② Participation by top management is necessary in order to make decisions regarding the huge amounts of investment in equipment for environmental measures.
③ Systematic employee education is necessary regarding environment-related laws, ordinances, and agreements, and regarding the function, organization, and operational standards of equipment etc.

An example of an environmental management system at a production factory is shown in Fig. 7.6.1.

Fig. 7.6.1 Organization of Environmental Management in Factories



An example of the activities of a special environmental department is shown in Table 7.6.1. In factories with many sources of pollution this department is split into management and technical groups, however, in factories with few sources of pollution it is common for someone to be put in charge of such.

Table 7.6.1.Jobs of Environmental Management Department in Factories

1. Formulation and Promotion of Environmental Management Plans ① Formulation of environmental management policy (annual). ② Consideration of measures for dealing with pollution sources,formulation of plans, implementation of measures, and evaluation of results. ③ Management of environment-related budget. ④ Employee education.
2. Government Response ① Reports based on laws, and ordinances. ② Accompanying on-site inspections by government.
3. Monitoring ① Monitoring of pollution sources. ② Organization and analysis of collected data. ③ Monitoring both inside and outside of factory. ④ Investigation of causes of problems and direction regarding improvement.
4. Other ① Dealing with complaints.

7.6..2. Environment Audit

Enterprises have been carrying out activities in accordance with environment-related laws and regulations. However, no matter how well enterprises abide by the law, new environmental problems continue to emerge. For example, global climate change on account of CO_2 emissions, widespread pollution on account of acid rain, and destruction of the ozone layer by chlorofluorocarbons etc. are environmental problems which must be solved on a global scale. It is difficult to estimate the causal relationship between individual enterprises and these problems due to their widespread and long-term nature.

It is becoming increasingly important for enterprises to take their initiative in areas such as energy-efficiency, resource-efficiency, the suppression of waste and contaminated waste. In order for such to be implemented on a continuous basis, it is thought that the establishment of a system of environmental management and environmental auditing is necessary.

Environment audit was considered by the ISO (International Organization for Standardization) in July of 1991 as an international standard and presently, work on the ISO14000 standard regarding environmental management and audit is being carried out.

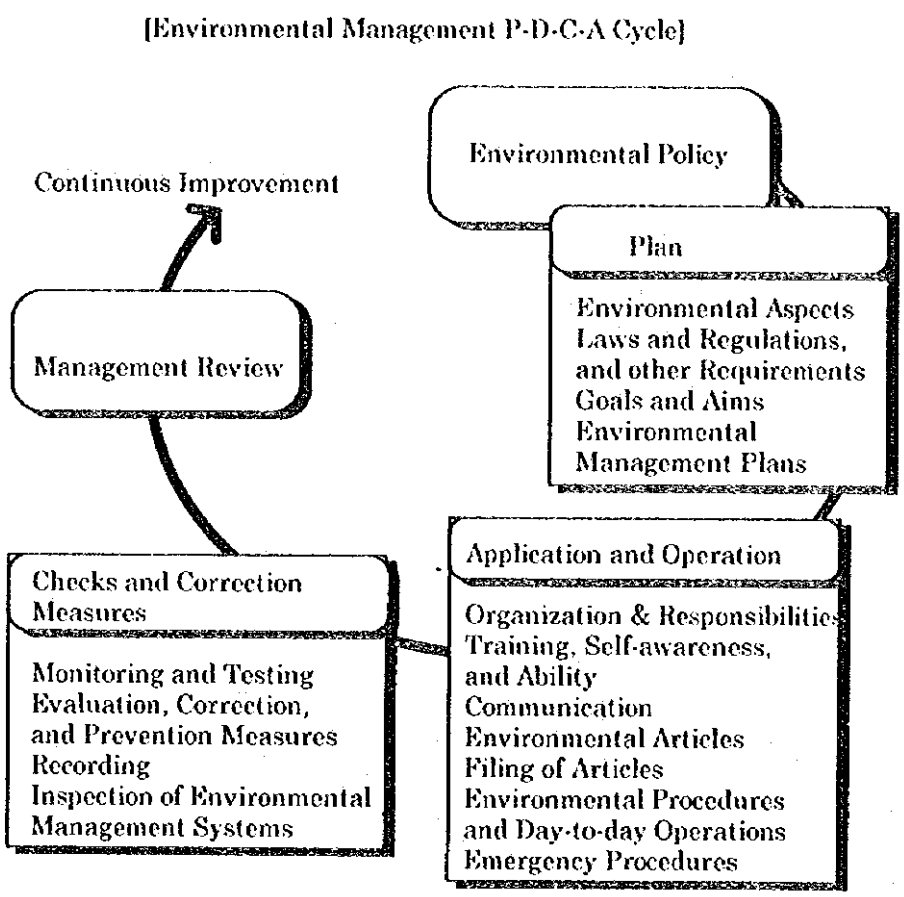
In December of 1990, the EU announced a draft report on environment audit with the aim of promoting environmental protection of areas within the EU. After some amendment, this was adopted on June 29, 1993 as the EC Eco-Management and Audit Scheme; EMAS. The aim of EMAS is the continuous improvement of environmental achievements. It consists of the following three schemes.

① The establishment and implementation of environmental policy, environmental plans, and environmental management systems at each establishment.
② The systematic and regular evaluation of environmental achievements.
③ The provision of information regarding environmental achievements.

In Japan, the number of enterprises establishing environmental management systems, carrying out environment audit, and publicly releasing the results of such of their own initiative is increasing. This is due to the fact that many enterprises have deep relationships with overseas countries through exporting their products, and it is therefore necessary that they show a positive attitude both domestically and internationally regarding environmental issues. There is also the fact that costs can be reduced through the establishment of environmental management systems, continuous environmental improvement, namely energy and resource efficiency.

An outline of the environmental management system being formulated by the ISO is shown in Figure 7.6.2.

Figure 7.6.2. Concept for Environmental Management



8. Introduction of Sewage Systems in Japan

8. Introduction of Sewage Systems in Japan

Sewage systems in Japan are not standardized. Their treatment methods, their charging systems, and the quality standards applied to the water they receive differ substantially depending on the policies of self-governing community bodies. The three primary types of systems in operation are introduced below.

Name of System	Characteristics	Charging System
(1) Wakagawa	: Coloring rate is regulated.	Progressive charging depending on both drainage volume and concentration
(2) Kashima Littoral	: Mainly industrial effluent from industrial zone	Progressive charging depending on pollutant concentration
(3) Tokyo Ariake	: Biological denitrification and phosphorus removal + ozone	Progressive charging depending on drainage volume

8.1 Wakagawa Sewage System of Wakayama City

8.1.1 Outline

Rivers which flow at the center of Wakayama City have no constant water discharge because their water levels fluctuate with the ebb and flow of the tide. They are so-called tidal rivers, and their basins are dotted with local industries such as dyeing plants, chemical plants, and leather plants. The volume of industrial effluent started increasing sharply in about 1950, and the laver culture at the lower reaches of the Wakagawa River was soon damaged. In 1955, a dam was constructed at the lower reaches of the Wakagawa River to divide the sea and the river. The primary object of sewage service at the time was to handle rainwater, and countermeasures against fouled sewage were not promptly taken. Consequently, stagnation of rivers and accumulation of black sludge reached peak levels in about 1970, and operation of the sewage system was then improved. In addition, seawater was pumped up above the dam to let the Wakagawa river flow upstream, and ultimately the seawater was taken to the upper reaches of the major Kinokawa River. This daring measure was successful in improving the water quality, but not in improving the views of the rivers. To meet the wishes of citizens and preserve a comfortable environment, Wakayama City became the first city in Japan to set regulations on water color and other conditions. To help business establishments installing pretreatment equipment for color treatment, the city furnished special loan and grants for paying a fixed rate of interest.

Moreover, as a measure to improve the treatment of the Wakagawa sewage system itself, coagulating sedimentation was added above biological treatment, and an ozonization process was added below. The cost of the added treatment is covered separately from sewage charges using the general revenue source of Wakayama City.

The Wakagawa River, the river to which the sewage system discharges its treated water, is still divided from the sea with a dam even now, and the river flows upstream into the city mixed with seawater.

8.1.2 Outline of Treatment Facilities

The flow rate of sewage (household effluent and industrial effluent) which flows in the sewage system is indicated in Fig. 8.1.1. The ratio of household effluent to industrial effluent is about 3:2.

The flow sheet of treatment facilities is indicated in Fig. 8.1.2. The quality standards of the effluent the sewage system receives, and the quality standards of the treated water the system discharges are shown in Table 8.1.1. Table 8.1.2 shows the particularly severe regulatory standard for water color, together with its measuring method.

8.1.3 Charging System

Progressive charging is applied to general foul water. A particularly low charge is applied to public bathhouses. Progressive charging depending on the flow rate and the concentration of pollutants is applied to industrial effluents which contain high concentrations of pollutants or are generated in large quantities, however, the charge is lower than that applied for general effluents from households and other sources.

Table 8.1.1 Charge Rate of Sewerage in Wakayama City

Sewer User Charges (For a month)

Division	Basic Charge		Excess Charge(for 1m³	
	Volume of fouled water removed	Charge	Volume of fouled water removed	Charge
General fouled water	Up to 10m³	500 yen	Over 10m³ up to 30m³	60 yen
			Over 30m³ up to 100m³	75 yen
			Over 100m³ up to 500m³	85 yen
			Over 500m³	95 yen
Fouled water from public bathhouses	For the removal of 1m³ fouled wate			10 yen

Water Quality Charges

When the volume of fouled water removed per month exceeds 1,000m³ or the concentration of the fouled water removed exceeds 200mg/l, water quality charges based on the concentration of the fouled water (shown in the table below) are added.

Water Quality Division		Charge (for 1m³)
Biochemical oxygen demand or chemical oxygen demand in a liter of fouled water	Over 200mg up to 300mg	10 yen
	Over 300mg	10 yen plus 8 yen for each 100mg over 300mg (fraction under 100mg is regarded as 100mg)
Volume of suspended matters in a liter of fouled water	Over 200mg up to 300mg	15 yen
	Over 300mg	15 yen plus 18 yen for each 100mg over 300mg (fraction under 100mg is regarded as 100mg)

(Note) Oxygen demand is applied as the larger of the volumes of biochemical oxygen demand and chemical oxygen demand.

Table 8.1.2 Emission Standards for Inlet and Outlet of Sewerage Treatment Plant

Emission Standards of Effluent and Discharge (Applied to Central Final Treatment Systems)

Item / Standard Value	Standard Value of Effluent prescribed by the Sewage Water Law	Standard Value of Discharge prescribed by the Water Pollution Control Law	ND
Temperature	Under 45 (40)°C	40°C or under	- -
PH	Over 5 (5.7) and under 9 (8.7)	5.8 or over and 8.6 or under	- -
BOD	Under 600(300)mg/l	30 (average 20)mg/l or under	0.5
COD	- -	60x160,784x10^{-6} =9.65t/D	0.5
SS	Under 600(300)mg/l	70(average 50)mg/l or under	1
No. of Coliform Groups	- -	3,000 groups/cm3 or under	1
Hexane Extracts	5 (mineral oil)mg/l or under, 30 (animal and vegetable oils)mg/l or under	5 (mineral oil)mg/l or under, 30 (animal and vegetable oils)mg/l or under	0.5
Iodine Demand	Under 220mg/l	- -	1
Total nitrogen	[Under 240(150)]	Under 120(average 60)	0.01
Total phosphorus	[Under 32(20)]	Under 16(average 8)	0.01
Cadmium	Under 0.05mg/l	Under 0.05mg/l	0.005
Cyanide	Under 0.5mg/l	Under 0.5mg/l	0.1
Organic phosphorus	Under 0.5mg/l	Under 0.5mg/l	0.1
Lead	Under 0.1mg/l	Under 0.1mg/l	0.005
Hexavalent chromium	Under 0.25mg/l	Under 0.25mg/l	0.02
Arsenic	Under 0.1mg/l	Under 0.1mg/l	0.005
Total mercury	Under 0.005mg/l	Under 0.005mg/l	0.0005
Alkyl mercury	Not detected.	Not detected.	0.0005
PCB	Under 0.003mg/l	Under 0.003mg/l	0.0005
Trichloroethylene	Under 0.3mg/l	Under 0.3mg/l	0.03
Tetrachloroethylene	Under 0.1mg/l	Under 0.1mg/l	0.01
Phenol	Under 5mg/l	Under 5mg/l	0.02
Copper	Under 3mg/l	Under 3mg/l	0.04
Zinc	Under 5mg/l	Under 5mg/l	0.15
Soluble iron	Under 10mg/l	Under 10mg/l	0.30
Soluble manganese	Under 10mg/l	Under 10mg/l	0.40
Total chromium	Under 2mg/l	Under 2mg/l	0.03
Fluorine compounds	Under 15mg/l	Under 15mg/l	0.1
Coloring rate	Under 80	Under 80	10.0
Transparency	- -	20 degrees or over	1.0
Residual chlorine	Under 2mg/l	Under 2mg/l	0.1

Note) Values in [ ] are not yet prescribed by the Sewage Water Law yet; values in ( ) are applied to manufacturers.

Table 8.1.3 Additional Color Standard for Sewerage in Wakayama City

Color: The coloring rate of effluent at the outlet shall be lower than 80.

Remarks

For measurement, use a 30cm transparency meter (with a white labeling board without black lines located at the bottom) and apply the dilution method.

(1) Production of sample water diluted by multiples of 10 and confirmation of color

Prepare a water sample at a dilution of 10:1 by taking 50ml of test water in a 500ml stoppered graduated cylinder and adding distilled water until the volume reaches 500ml. Pour the water into a transparency meter up to the 30cm graduation and compare the color with that of a standard transparency meter filled to the same graduation with pure distilled water by putting the meters side by side. If it is confirmed that the water is colored, prepare a second sample solution diluted to a concentration of 100:1 by taking 50ml of the first sample water diluted to concentration 10:1, dispensing it into a second 500ml stoppered graduated cylinder, and adding distilled water until the total volume reaches 500ml. Once again, pour the water in a transparency meter up to the 30cm graduation, and compare the color with that of the standard transparency meter. If, again, it is confirmed that the water is colored, prepare a third sample solution diluted to a concentration of 1,000:1 using the same procedures and repeat the comparison. As long as color can still be confirmed, continue diluting the solution by multiples of ten. Using this method, determine the maximum dilution at which the color can still be distinguished.

(2) Color Checking Method

Put the standard transparency meter and the transparency meter filled with diluted sample water side by side, and light both meters evenly with a cool white fluorescent lamp. Under this condition, visually check the color from above.

(3) Production of sample water diluted by multiples of 2

Dispense the sample water diluted to the maximum dilution at which the color can be distinguished in a stoppered graduated cylinder, and produce a series of water samples diluted by multiples of 2; namely, 1, 2, 4, 8, and 16, in transparency meters.

(4) Calculation of Coloring Rate

a. Each of 6 measurers compares the color of the water diluted by multiples of 2 in the transparency meter with that of the standard transparency meter, and judges if the water is "distinguishable" or "indistinguishable." The normal logarithmic value of each measurer is calculated in the following way based on the dilution multiples of the measurer.

Normal logarithmic value = 1/2 x ($\log a_1 + \log a_2$)

i) "a_1" is the maximum multiple of dilution judged "distinguishable."

ii) "a_2" is the minimum multiple of dilution judged "indistinguishable."

Then the normal logarithmic values of the measurers are summed up excluding the maximum value and the minimum value (whenever there are plural maximum and/or minimum values, exclude only one value in each case), and the average value Cm of the remaining three measurers' values is calculated.

b. The coloring rate is the value calculated with the following equation.

Coloring rate = 10^{Cm}

				A	B	C	D	E	Total	Average		Coloring rate
	O	O	O	(0.85)	(0.85)	(0.85)			2.55	0.85	7.08	< 10
10	O	O	×	(0.85)	(0.85)	1.15			2.85	0.95	8.91	< 10
(5-10)	O	×	×	(0.85)	1.15	1.15			3.15	1.05	11.22	11.2
	O	O	O	1.15	1.15	1.15			3.45	1.15	14.13	14.1
20	O	O	×	1.15	1.15	1.45			3.75	1.25	17.78	17.8
(10-20)	O	×	×	1.15	1.45	1.45			4.05	1.35	22.39	22.4
	O	O	O	1.45	1.45	1.45			4.35	1.45	28.18	28.2
40	O	O	×	1.45	1.45	1.75			4.65	1.55	35.48	35.5
(20-40)	O	×	×	1.45	1.75	1.75			4.95	1.65	44.67	44.7
	O	O	O	1.75	1.75	1.75			5.25	1.75	56.23	56.2
80	O	O	×	1.75	1.75	2.05			5.55	1.85	70.79	70.8
(40-80)	O	×	×	1.75	2.05	2.05			5.85	1.95	89.13	89.1
	O	O	O	2.05	2.05	2.05			6.15	2.05	112.20	112
160	O	O	×	2.05	2.05	(2.36)			(6.46)	(2.15)	141.25	(141)
(80-160)	O	×	×	2.05	(2.36)	(2.36)			(6.77)	(2.26)	181.97	(182)

Maximum value

Minimum value

Fig.8.1.1 Flow Sheet of Effluent

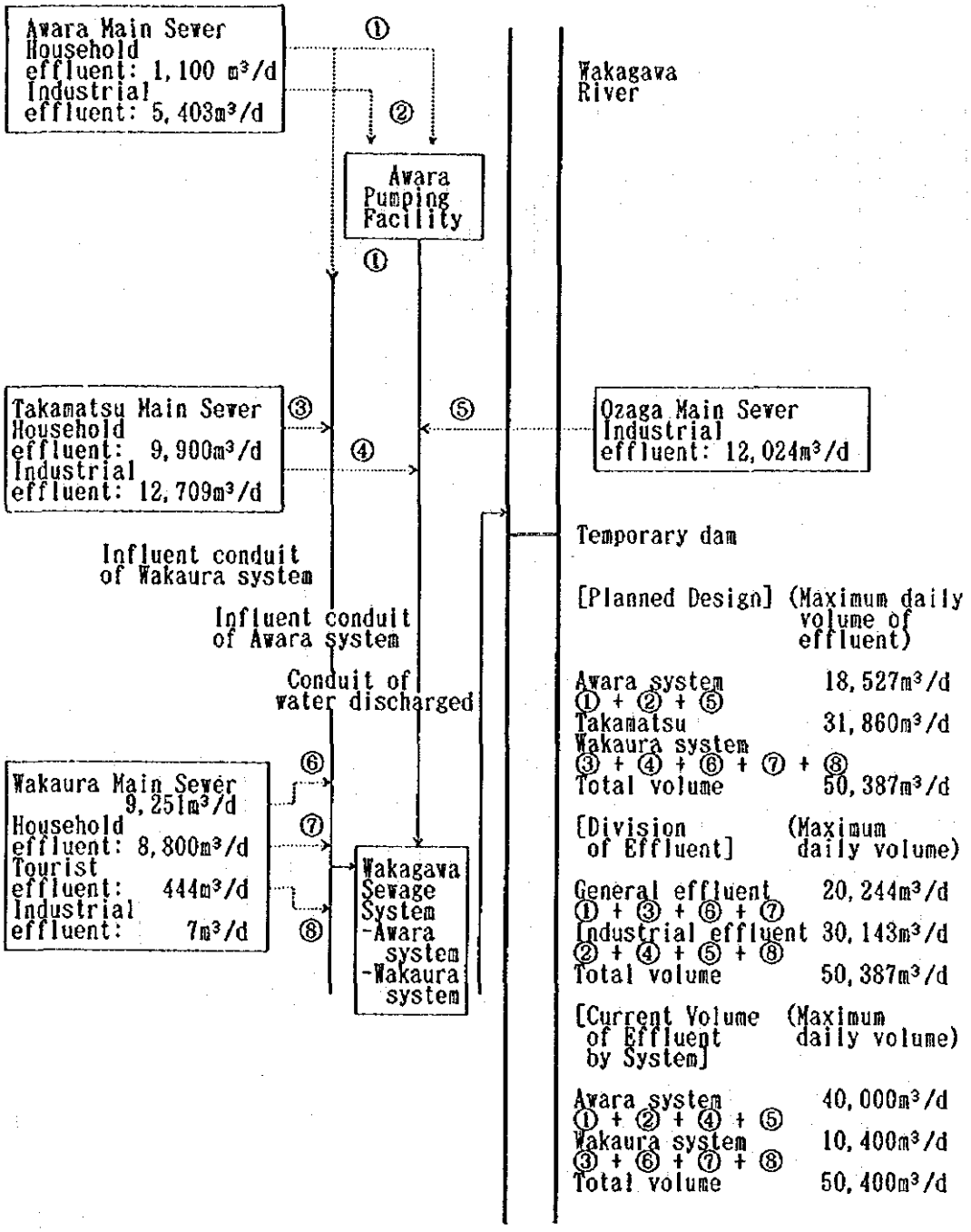
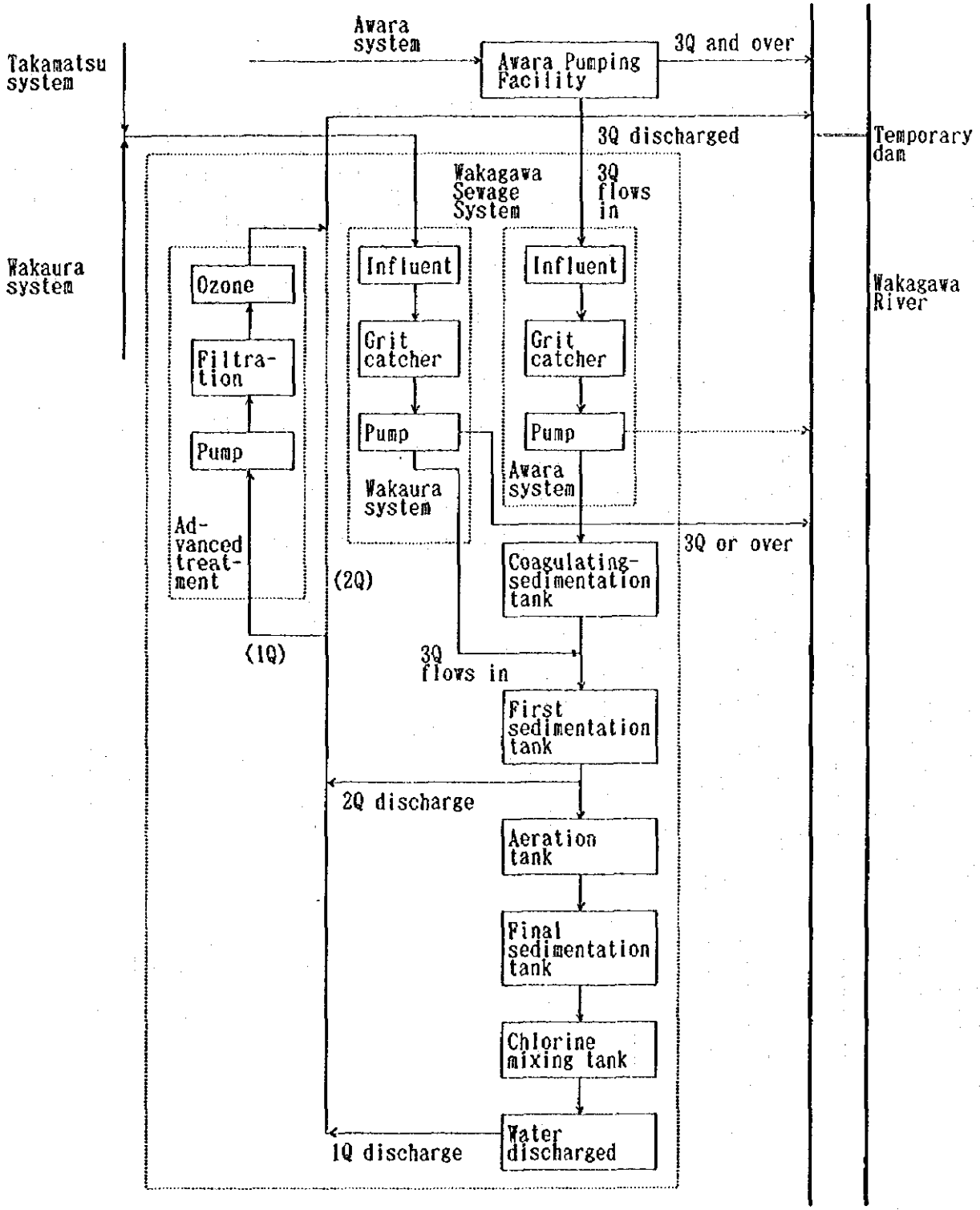


Fig.8.1.2 Flow Sheet of Treatment



8.2 Kashima Littoral Specified Public Sewage System

8.2.1 Outline

Kashima Littoral Specified Public Sewage System, located in the Kashima Littoral Industrial Zone on the coast of the Sea of Kashima, leads the effluent from plants and business establishments in the Kaminoike East and West Districts and the Hazaki District (excluding Industrial section of the Takamatsu District) and the household effluent of the neighboring districts to the Fukashiba Sewage System via the main sewer. Biological treatment and chemical treatment are applied to the effluent at the sewage system, and the treated water is discharged to the Sea of Kami Kashima.

The system treats the effluent of 98 business establishments and 105 plants. Of the fouled water volume treated, industrial effluent accounts for 92 - 93%, and household effluent for the remainder. The system has been operated since September 1970.

About half of the above-mentioned plants have equipment for pretreatment.

8.2.2 Circumstances of Wastewater Treatment

1) Treatment process

From each plant -> Grit catcher -> Aerated oil separation tank -> Balancing tank -> Coagulation basin -> Aeration tank -> Final sedimentation basin -> Disinfection chamber -> Discharge

There is also a dewatering and incinerating furnace for sludge.

2) Water volume and quality

(1) Water volume 100,000 m³/d (1995), equipment capacity 125,000 m³/d

(2) Water quality Outlined as follows (details are indicated in Table 8.2.1.)

		System's Inflow Standards	System's Discharge Standards
Water Temp.	°C	45>	
pH		5 - 9	5.8 - 8.6
BOD	mg/l	600	20
COD	mg/l	600	40 (daily average) 50 (maximum)
SS	mg/l	600	40 (dailyaverage) 50 (maximum)
Oil	mg/l	20	Mineral oil N-Hex 2.0 (daily average) 3.0 (maximum) Animal and vegetable oils N-Hex 2.0 (daily average) 3.0 (maximum)

Although there is no regulation on P, P must be less than 4.8mg/l in the raw water and less than 1.7mg/l in the treated water.

3) Running cost

Actual running cost per 1m³ of wastewater in 1995 was as indicated below. Costs for sludge disposal and the repair of equipment and machinery are included in the running cost.

Chemical cost	: 13 yen
Power cost	: 5 yen
Personnel cost	: 30 yen (incl. work consignment fee of 20 yen)
Others	: 12 yen
Total	: 60 yen/m³

8.2.3 Circumstances of Management

1) Water volume management

A water meter is equipped in each plant, and each meter is checked at the beginning of every month.

2) Operator

In total, 60 out of 90 employees are operators. Only monitoring personnel are on duty at night.

3) Analyzing personnel: 9 persons (6 employees and 3 consignees)

4) Others

- Spot inspections of water quality and water volume are conducted in each plant at least once a month.

- Liaison conferences are held 4 - 5 times a year between the plants, and a system has been established to encourage the discussion on pertinent subjects and operational and managerial improvements.

8.2.4 Charging System

The charge is the sum of the charge on water volume and the charge on water quality.

That is:

① Charge on water volume is 42 yen per $1m^3$ of fouled water discharged

② Charge on water quality is as indicated in Table 8.8.2 per $1m^3$ of fouled water discharged

③ An additional charges are levied on fouled water discharged whose volume exceeds 110% of the volume contracted between each plant and the system, and on fouled water whose concentration exceeds 120% of the concentration contracted between each plant and the system. In each case, the additional charge is 52 yen per $1m^3$ of fouled water.

Note: Volume of fouled water discharged prescribed above is the total of the values obtained taking the daily average volumes of fouled water discharged in a month in three stages and multiplying them by the relevant numeric values shown in the right column of the table below.

Stage of daily average volume of fouled water discharged per month	Numeric value
Up to $3,000m^3$	1.0
Over $3000m^3$ up to $5,000m^3$	0.9
Over $5,000m^3$	0.8

Charges are decided as indicated above, but the charges enterprises actually pay are around 100 - 120 yen/m^3.

Table 8.2.1. Regulatory Standard of Water Quality Related with Kashima Littoral Public Sewrage System

Division / Item	Environmental Standards	Effluent Standards	Removal Standards for Specified Business Establishments (Chapter 12, Item 2 of the Law)	Standards for the Installation of Industrial Pretreatment Facilities		Standard for Industrial Waste Landfill
				Chapter 12 of the Law	Use Contract	
Environmental Items:						
Water temperature °C				Over 45	Over 45	
pH -	7.0 - 8.3	5.8 - 8.6		Under 5 Over 9	Under 5 Over 9	
COD mg/l	8.0 or under	50(40)			Over 600	
BOD mg/l		20*			Over 600	
SS mg/l		50(40)			Over 600	
Hexane extracts mg/l		3(2)				
(mineral oil) mg/l						
Hexane extracts mg/l		3(2)				
(mineral and mg/l						
vegetable oils) mg/l						
Phenol mg/l		5	10			
Copper mg/l		3	3			
Zinc mg/l		5	5			
Soluble iron mg/l		10	10			
Soluble manganese mg/l		10	10			
Chromium mg/l		2	2			
Fluorine mg/l		15	15			
Coliform group number groups/cm³		3000				
DO mg/l	Over 2					
Iodine demand mg/l				Over 220		
Hazardous Substances: mg/l						
Cadmium	0.01	0.1	0.1			0.3
Cyanide	Not detected	1	1			1
Organic Phosphorus	-	1	1			1
Lead	0.01	0.1	0.1			0.3
Hexavalent chromium	0.05	0.5	0.5			1.5
Arsenic	0.01	0.1	0.1			0.3
Total mercury	0.0005	0.005	0.005			0.005
Alkyl mercury	Not detected	Not detected	Not detected			Not detected
PCB	Not detected	0.003	0.003			0.003
Trichloroethylene	0.03	0.3	0.3			0.3
Tetrachloroethylene	0.01	0.1	0.1			0.1
Dichloromethane	0.02	0.2	0.2			0.2
Carbon tetrachloroethylene	0.002	0.02	0.02			0.02
1,2-Dichloroethane	0.004	0.04	0.04			0.04
1,1-Dichloroethylene	0.02	0.2	0.2			0.2
Cis-1, 2-Dichloroethylene	0.04	0.4	0.4			0.4
1,1,1-Trichloroethane	1	3	3			3
1,1,2-Trichloroethane	0.006	0.06	0.06			0.06
1,3-Dichloropropene	0.002	0.02	0.02			0.02
Tiurum	0.006	0.06	0.06			0.06
Cymadine	0.003	0.03	0.03			0.03
Thiobenculp	0.02	0.2	0.2			0.2
Benzene	0.01	0.1	0.1			0.1
Selenium	0.01	0.1	0.1			0.3

Table 8.2.2 Table of Charges

Concentration of Fouled Water (F)	Rate
Under 120	25 yen
From 120 to 239	38 yen
From 240 to 359	50 yen
From 360 to 479	63 yen
From 480 to 599	75 yen
From 600 to 719	88 yen
From 720 to 839	100 yen
From 840 to 959	113 yen
From 960 to 1,079	125 yen
From 1,080 to 1,199	138 yen
From 1,200 to 1,319	150 yen

Remarks:
The following equation shall be used to calculate the concentration of the fouled water.

$$F = \frac{B \div C}{2} \div S \div 6N$$

B, C, S and N of the above equation are:

B Biochemical oxygen demand of fouled water (unit : mg/l in five days)

C Chemical oxygen demand of fouled water (unit : mg/l)

S Quantity of suspended solids in fouled water (unit : mg/l)

N Oil content of fouled water (unit : mg/l)

8.3 Ariake Sewage System in Tokyo Metropolis

8.3.1 Outline

Ariake Sewage System is the most recently constructed sewage system in the littoral subcenter of Tokyo Metropolis. It started operation in July 1996. The equipment in the system currently has a capacity to process 30,000 m^3/d, while the system was initially designed to process a maximum of 120,000 m^3/d. As the subcenter project was suspended and the population has not increased to the estimated value, however, only about 5,000m^3 of water is currently being received per day. Denitrification and phosphorus-removal equipment introducing biological treatment began operation as recently as September. Since their operation has not reached a steady condition, complete data have not yet been obtained.

8.3.2 Outline of Equipment:

Estimated water volume : 120,000m^3/d
Estimated volume of treated water : 40,000m^3/d
Treatment method : Anaerobic anoxicaerobic + biofilm filtration + ozone
Removal system : Separate system
Sludge is pumped to the Nanbu Sewage System and treated there.

Estimated quality of treated water

Item	Quality of Influent	Quality of Treated Water	
		Anaerobic/anoxic/aerobic mg/l	Biofilm filtration mg/l
BOD	250	20	8
SS	230	20	5
T-N	5.6	0.5	0.5

Process:

Primary sedimentation basin -> Anaerobic tank -> Denitrification tank -> Aerobic tank -> Biofilm tank -> Ozonization process -> Bacteria reduction with chlorine -> Reused in the toilets of the district

Anaerobic tank 2,500m^3, Residence time 2 hours
Denitrification tank 6,250m^3, Residence time 5 hours
Aerobic tank 10,000m^3, Residence time 8 hours
Biofilm tank 28m^2/bed x 28 beds, Thickness of the anthracite filter cell 2m, Filtration rate 200m/d

Construction cost: 5.3 billion yen
Items: Existing equipment 30,000m^3/d
Construction 120,000m^3/d

Recycled water: The whole district is equipped with double piping for public water supply and for recycled water of sewage, and the recycled water is used for toilets.

Charge on recycled water: 260 yen/m^3, of which 30 yen/m^3 is electric charge for ozonization treatment. Tap water charge is 420 yen/m^3.

8.3.3 Evaluation of Biological Denitrification and Phosphorus Removal

Only the equipment cost and running cost exceed those of the normal activated-sludge method. Biological denitrification and phosphorus removal compare favorably with phosphorus removal by coagulation method, a process which requires treatment of a large quantity of sludge.

8.3.4 Sewer User Charges

Table of Sewer User Charges (per month)

Type of Fouled Water	Volume of Discharge (m^3)	Rate (Yen)
	Less than $10m^3$	536 yen
	11 - $20m^3$	112 yen for $1m^3$
	21 - $50m^3$	151 "
General Fouled Water	51 - $100m^3$	179 "
	101 - $200m^3$	208 "
	201 - $500m^3$	252 "
	501 - $1,000m^3$	291 "
	More than $1,001m^3$	331 "
Fouled Water of	Less than $10m^3$	268 yen
Bathhouses	More than $11m^3$	27 yen for $1m^3$

Table 8.3.5 Emission Standard for Effluent

Emission Group		Emission standard
Cadomium		0.1mg/l or under
Cyanide		1mg/l or under
Organic phosphorus		1mg/l or under
Lead		0.1mg/l or under
Hexavalent chromium		0.5mg/l or under
Arsenic		0.1mg/l or under
Total mercury		0.005mg/l or under
Alkyl mercury		To be kept undetected
PCB		0.003mg/l or under
Trichloroethylene		0.3mg/l or under
Tetrachloroethylene		0.1mg/l or under
Dichloromethane		0.2mg/l or under
Carbin tetrachloroethylene		0.02mg/l or under
1,2-Dichloroethane		0.04mg/l or under
1,1-Dichloroethylene		0.2mg/l or under
Cis-1,2-Dichloroethylene		0.4mg/l or under
1,1,1-Trichloroethane		3mg/l or under
1,1,2-Trichloroethane		0.06mg/l or under
1,3-Dichloeopropene		0.02mg/l or under
Tiurum		0.06mg/l or under
Cymadine		0.03mg/l or under
Thiobenculp		0.2mg/l or under
Benzene		0.1mg/l or under
Selenium		0.1mg/l or under
Total chrome		2mg/l or under
Copper		3mg/l or under
Zinc		5mg/l or under
Phenol		5mg/l or under
Iron(soluble)		10mg/l or under
Manganese(soluble)		10mg/l or under
Fluorine		15mg/l or under
Biochemical Oxygen Demand (BOD)		Less than 600mg/l (less than 300mg/l)
Quantity of Suspended Solids (SS)		Less than 600mg/l (less than 300mg/l)
Normal Hexane extract	Mineral oil	5mg/l or under
	Animal and vegetable oils	30mg/l or under
Nitrogen Content		Less than 240mg/l (Less than 150mg/l)
Concentration of Hydrogenion (pH)		Above 5, under 9 (Above 5.7, under 8.7)
Temperature		Under 45°C (Under 40°C)
Consumption of Iodine		Under 220mg/l

Note: 1. The numerical values in the brackets are the standards for the manufacturing industry and gas suppliers.
2. Some of these standards may not apply to some chemical substances or items, depending on the volume of the effluent.

Referenced Literature

(1) Guidelines and Comments on Planning and Designing of Sewerage Facilities, by Japan Sewage Works Association (1994)
(2) Guidelines for Operation and Maintenance of Sewage Works, by Japan Sewage Works Association (1979)
(3) Technology of Water Treatment Mainly on Factory Effluent at Wakagawa Final Sewage Treatment Plant, by Shigekazu Kawasaki, Wakayama City Sewage Department (1996)
(4) Environmental Pollution Prevention Technology and Legislation (Water Quality Edition), compiled by Editorial Committee on Environmental Pollution Technology and Legislation, Japan Environmental Management Association for Industry (1993)
(5) "How to Treat Infectious Wastes Properly", by Tokyo Metropolitan Government, Bureau of Public Cleansing (1993)
(6) Guide to Treatment of Industrial Wastes, by Tokyo Metropolitan Government, Bureau of Public Cleansing (1996)
(7) Revised Complete Course on Treatment Measures for Small-Scale Enterprises Effluent, by Environmental Pollution Control Technology Friendship Society (1991)
(8) Survey of Safety Control and Security Systems of Water Pollution Control Facilities (Part 2), by Japan Industrial Machinery Industry Association (1995)
(9) Effect on Biological Treatment of Heavy Metals, Sewage Works Association Magazine Vol.3, No.29 (1966)
(10) Citizen Corporation Catalog
(11) Quality of the Environment in Japan, 1996 Edition, by Japan Environment Agency (1996)
(12) Environment Laws, 1994 Edition, by Environment Legislation Research Society of Japan Environment Agency (1994)
(13) Environmental Protection of Tokyo, by Tokyo Metropolitan Government
(14) General Survey of Environment, 1994 Edition, by Ministry of International Trade and Industry Data Survey Society (1993)
(15) Outline of Aid Measures for Environmental Control - Financial Measures, by Urushihata, Environment Control Vol.32, No.5 (1996)
(16) Environment Control and Inspection - International Standardization and Corporate Action, by Tokyo Chamber of Commerce Environment Committee (1995)
(17) Bylaws and Regulations on Control of Color, etc. of Wakayama City Effluent, by Environment Protection Office, Health and Sanitation Department, Wakayama City (1991)
(18) Wakayama City Sewerage Bylaws and Enforcement Regulations, Wakayama City Sewerage Department (1991)
(19) Ibaraki Prefecture Kashima Coastal City Project, Collection of Special Cases of Sewerage Enterprises, (Ibaraki Prefecture 1996)
(20) Tokyo Ariake Sewage Treatment Plant Data (1996)

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